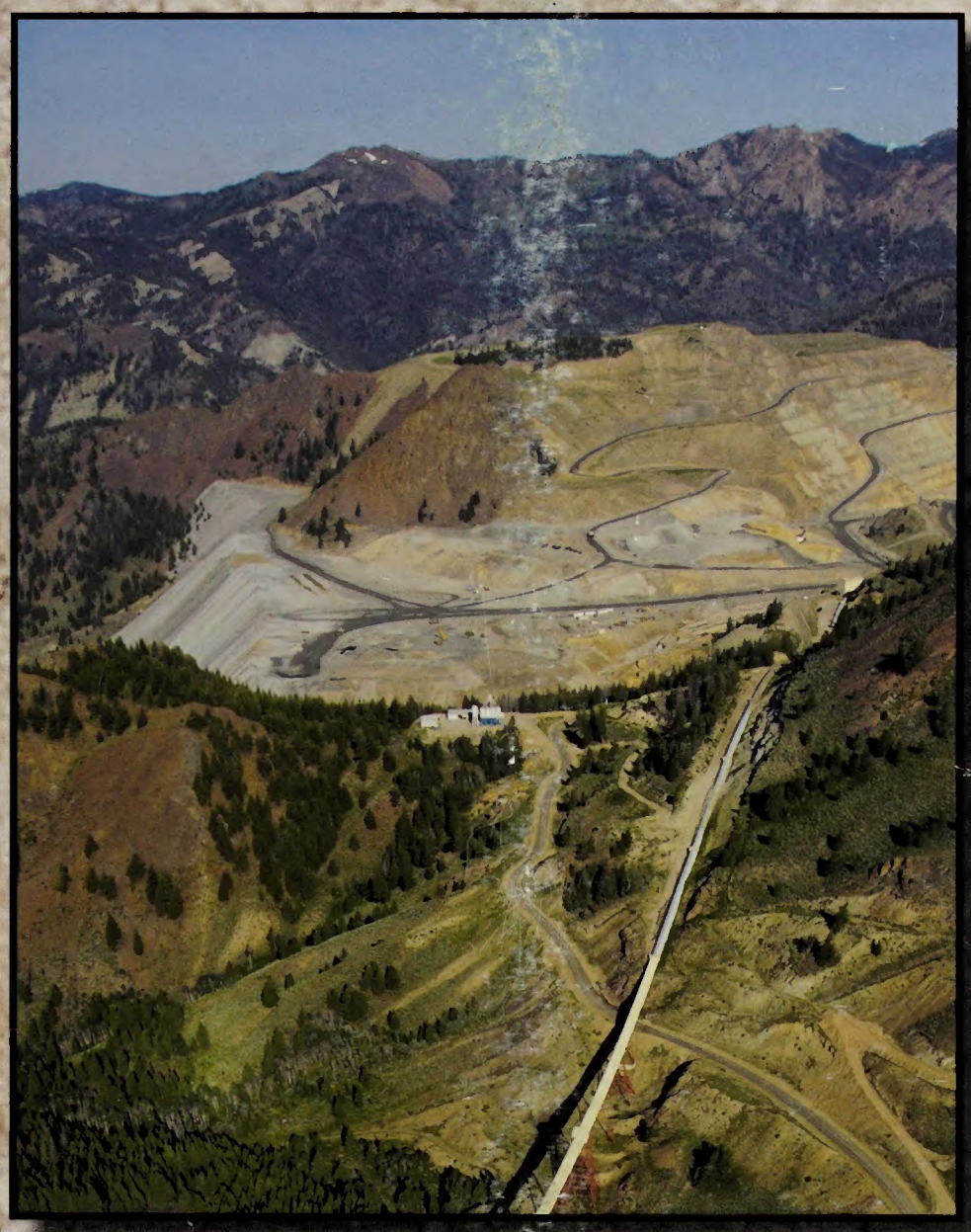
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Final Environmental Impact Statement and Proposed Resource Management Plan Amendment for the Thompson Creek Mine Expansion and Public Land Disposal, Custer and Bannock Counties, Idaho

VOLUME I



Case File Numbers:

IDI-33145 (Plan of Operations)
IDI-35728-FD (Federal/Selected Land)
IDI-35728-PT (Private/Offered Lands)

NEPA Serial Number: DOI-BLM-ID-I030-2011-0001-EIS

January 2015

BLM

BLM Mission Statement

It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

DOI-BLM-ID-I030-2011-0001-EIS

Abstract: This final environmental impact statement/proposed resource management plan amendment describes the environmental effects of two proposals by Thompson Creek Mining Company: 1) a modified mining plan of operations (MMPO) for the Thompson Creek Molybdenum Mine near the City of Clayton in Custer County, Idaho; and 2) an exchange of Federal land at the mine for private lands owned by the company in Custer and Bannock counties, Idaho. In response to these proposals and a Section 404 Clean Water Act permit application, 1) the Bureau of Land Management (BLM) will decide whether to approve the portion of the MMPO involving BLM-administered land; 2) the Forest Service will decide whether to approve the portion of the MMPO involving National Forest System land; 3) the US Army Corps of Engineers will decide whether to issue a permit under Section 404 of the Clean Water Act to discharge fill materials into waters of the US as required by the MMPO; 4) the BLM will decide whether to amend the Challis Field Office 1999 resource management plan to identify the BLM-administered land in the land exchange proposal as available for disposal (exchange or sale); and 5) the BLM will decide whether to approve a land disposal action. The final environmental impact statement describes the environmental effects of the two proposals and alternatives to the proposals in a set of MMPO alternatives and an independent set of land disposal alternatives. Alternative M2 (MMPO as submitted) and Alternative L2 (land exchange proposal as submitted) are preferred by the responsible officials.

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Final Environmental Impact Statement and Proposed Resource Management Plan Amendment for the Thompson Creek Mine Expansion and Public Land Disposal, Custer and Bannock Counties, Idaho.

Lead Agency: US Department of the Interior, Bureau of Land Management, Idaho Falls District,

Challis Field Office

Cooperating Agencies: US Department of Agriculture, Forest Service
US Army Corps of Engineers
US Environmental Protection Agency
Idaho Department of Lands
Idaho Department of Environmental Quality

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http://www.blm.gov/id/st/en/prog/nepa_register/TCM-exlx_EIS.html

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BUREAU OF LAND MANAGEMENT
Challis Field Office
1151 Blue Mountain Road
Challis, Idaho 83226

In Reply Refer To:
2200/3809/IDI-33145/IDI-35728 (IDI030)

Dear Reader:

Enclosed for your review is the *Final Environmental Impact Statement (EIS) and Proposed Resource Management Plan Amendment* (FEIS/PRMPA) *for the Thompson Creek Mine Expansion and Public Land Disposal, Custer and Bannock Counties, Idaho*. There was a 30 day public scoping period for the project pursuant to a Notice of Intent to prepare an EIS published in the *Federal Register* on August 3, 2010 (75 FR 45652). A 90 day public comment period was held for the draft EIS/draft resource management plan amendment (DEIS/DRMPA) upon publication of the EPA Notice of Availability (NOA) for the DEIS/DRMPA in the *Federal Register* on March 21, 2014 (75 FR 06113). A 30 day FEIS/PRMPA review period was initiated by publication of the EPA NOA in the *Federal Register*. The Bureau of Land Management (BLM) has also published a NOA for the FEIS/PRMPA in the *Federal Register*.

Copies of the FEIS are available in the BLM Challis Field Office at 1151 Blue Mountain Road, Challis, Idaho from 7:45 a.m. to 4:30 p.m., Monday through Friday, except Federal holidays. Copies are also available at http://www.blm.gov/id/st/en/prog/nepa_register/TCM-exlx_EIS.html.

Subsequent to the 30 day review period for the FEIS/PRMPA, the responsible officials from the BLM, US Forest Service (Forest Service), and US Army Corps of Engineers (USACE) will each prepare a record of decision (ROD) for the components of the project for which the officials have respective authority, and for which there are distinct objection processes (see the Executive Summary for more details).

The FEIS/PRMPA was prepared in response to a modified mining plan of operations (MMPO) and land exchange proposed by Thompson Creek Mining Company. The Thompson Creek Molybdenum Mine is 7 miles northwest of Clayton and 21 miles southwest of Challis in Custer County, Idaho. The mine has been in operation since 1981 and is authorized for approximately 3,300 acres of surface disturbance, of which approximately 2,300 acres are on private land, approximately 750 acres are on BLM-administered land, and approximately 250 acres are on National Forest System land. The current surface disturbance at the mine is approximately 2,800 acres. The MMPO would allow an approximate 10 year extension of the mine life with the necessary expansion of the waste rock and tailings storage facilities, re-alignment of a power line, and revised long-term water management. These activities would require additional authorized surface disturbance on approximately 200 acres of BLM-administered land, 185 acres of National Forest System land, and 110 acres of private land.

The land exchange proposal is an offer to exchange approximately 900 acres of private lands owned by Thompson Creek Mining Company in Custer and Bannock counties for approximately 5,100 acres of

selected, BLM-administered land involving the mine in Custer County. The offered lands are the Broken Wing Ranch (813 acres) in Custer County and the Garden Creek property (80 acres) in Bannock County. The current Challis RMP does not identify the selected land as available for disposal. Therefore, in addition to evaluating the land exchange proposal, the FEIS also evaluates amending the RMP to identify the selected land as suitable for disposal pursuant to the Federal Land Policy Management Act of 1976, as amended.

The FEIS presents a set of three MMPO alternatives, and an independent set of five land disposal alternatives. That is, the MMPO alternatives would not be affected by any of the land disposal alternatives; the mine would not operate differently depending on Federal or private ownership of the selected land. The alternatives were developed and analyzed based on issues/concerns identified during the internal and public scoping process. The FEIS will be the basis for decisions by the BLM, Forest Service, and USACE. For the MMPO alternatives, each agency will issue a decision for the portion of the mining operations under the agencies' respective authorities. The major components of the operations subject to these authorities are the following:

- BLM – storage of waste rock south of the open pit and long-term water management;
- Forest Service – storage of waste rock north of the open pit, expansion of the tailings storage facility, re-alignment of a section of power line; and
- USACE – 404 permit for waters of the US that would be filled as part of mining operations.

The BLM will also issue a decision for the land disposal alternatives (exchange, sale, no action). If a land disposal action alternative is selected, the BLM will amend the Challis RMP to allow the land disposal to occur. We appreciate your interest in the project. If you have any questions or need additional information, please contact Ken Gardner, project manager, at the BLM Challis Field Office, telephone: (208) 879-6210; email: ksgardner@blm.gov.

Sincerely,

/s/ Todd Kuck
Todd Kuck
Field Manager

ACRONYMS, UNITS, AND CHEMICAL SYMBOLS

ACRONYMS, UNITS, AND CHEMICAL SYMBOLS

4WD	four-wheel drive
ACEC	area of critical environmental concern
AIRFA	American Indian Religious Freedom Act
Al	aluminum
AP	acid generation potential
AQCR	air quality control regions
ARD	acid rock drainage
ARPA	Archaeological Resources Protection Act
As	arsenic
AUM	animal unit month
BA	biological assessment
Ba	barium
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMP	best management practice
Br^-	bromium ion
BURP	Beneficial Use Reconnaissance (Project) Program
BWR	Broken Wing Ranch
Ca	calcium
Ca^{2+}	calcium ion
CAA	Clean Air Act
$CaCO_3$	calcium carbonate
CCC	criterion continuous concentration
Cd	cadmium
CEQ	Council on Environmental Quality
CESA	cumulative effects study area
CESQG	conditionally exempt small quantity generator
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGP	construction general permit
CH_4	methane
CHSU	critical habitat subunit
Cl^-	chloride ion
CMC	criteria maximum concentration
Co	cobalt
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide-equivalent
COC	constituent of concern
Cr	chromium
Cr (III)	chromium ion, Cr^{3+}
Cr (IV)	chromium ion, Cr^{4+}
CTNF	Caribou-Targhee National Forest
Cu	copper

CWA	Clean Water Act
DAU	data analysis unit
dB	decibel
dBA	A-weighted decibels
DEIS	draft environmental impact statement
DOI	Department of the Interior
DPS	distinct population segment
DRMPA	draft resource management plan amendment
ECA	equivalent clearcut area
EFH	essential fish habitat
EIS	environmental impact statement
EO	Executive Order
EPA	Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera
ERMA	extensive recreation management area
ESA	Endangered Species Act
ESU	evolutionary significant unit
F	fluorine
F^-	fluoride ion
Fe	iron
FEIS	final environmental impact statement
FLPMA	Federal Land Policy Management Act
FMU	fire management unit
FPOM	fine particulate organic matter
FSEIS	final supplemental environmental impact statement
GAP	Gap Analysis Program
GHG	greenhouse gas emission
GLO	General Land Office
gpm	gallons per minute
GWP	global warming potential
HAP	hazardous air pollutant
HBI	Hilsenhoff's Biotic Index
HCO_3^-	bicarbonate
HDPE	high density polyethylene
HFC	hydroflourocarbons
Hg	mercury
HMA	herd management area
HUC	hydrologic unit code
Hz	hertz
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDPR	Idaho Department of Parks and Recreation
IDWR	Idaho Department of Water Resources
IR	integrated report
IRA	inventoried roadless area

ITD	Idaho Transportation Department
K	potassium
K^+	potassium ion
KOP	key observation point
kV	kilovolt
kW-hr	kilowatt per hour
LAU	lynx analysis unit
L_{DN}	day-night average sound level
L_{EQ}	equivalent continuous noise level
L_P	sound pressure level
LREC	Lost River Electric Cooperative
LRMP	Land and Resource Management Plan
LWD	large woody debris
MA	management area
mbf	1,000 board feet
MBTA	Migratory Bird Treaty Act
Mg	magnesium
Mg^{2+}	magnesium ion
mg/L	milligrams per liter
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
µPa	micropascal
MIS	management indicator species
MMPO	modified mining plan of operations
Mn	manganese
mph	miles per hour
Mo	molybdenum
MoO_3	tech moly or molybdenum trioxide
MoS_2	molybdenite
MOU	Memorandum of Understanding
MP	mile post
MPG	major population group
MPO	mining plan of operations
MSHA	Mine Safety and Health Administration
MT	million metric tons
M_W	moment magnitude
N_2O	nitrous oxide
Na	sodium
Na^+	sodium ion
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NFS	National Forest System
NH_3	ammonia
NHPA	National Historic Preservation Act

Ni	nickel
NMFS	National Marine Fisheries Service
NO_x	nitrogen oxides
NO_2^-	nitrite ion
NO_3^-	nitrate ion
NOA	Notice of Availability
NOAA	National Ocean and Atmospheric Administration
NOEP	Notice of Exchange Proposal
NOI	Notice of Intent
NP	neutralization potential
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTU	nephelometric turbidity units
O_3	ozone
OHV	off-highway vehicle
Pb	lead
PCTR	personal current transfer receipts
PEM	palustrine emergent
PFC	properly functioning condition
PFC	perflourocarbons
PFO	palustrine forested
PGH	preliminary general habitat
pH	a measure of acidity or alkalinity of a solution on a logarithmic scale; pH 7 is neutral and values below pH 7 are acidic
PILT	payment in lieu of taxes
PM	particulate matter
ppb	parts per billion
PPH	preliminary priority habitat
PRMPA	proposed resource management plan amendment
PSD	prevention of significant deterioration
PSS	palustrine scrub-shrub
PWR	public water reserves
PWTP	process water treatment plant
RAC	Resource Advisory Committee
RCRA	Resource Conservation and Recovery Act
RMI	river macroinvertebrate index
RMP	Resource Management Plan
ROD	Record of Decision
ROS	recreation opportunity spectrum
ROW	right-of-way
RSM	recreation settings matrix
SAG	semi-autogenous grinding
Sb	antimony
SCNF	Salmon-Challis National Forest

Se	selenium
SF_6	sulfur hexafluoride
SH	State highway
SHPO	State Historic Preservation Office
SIL	significant impact level
SMA	special management area
SMI	stream macroinvertebrate index
SO_x	sulfur oxides
SO_4^{2-}	sulfate ion
SPCC	spill prevention, control, and countermeasures
SPL	sound pressure level
SRD	seepage return dam
SREC	Salmon River Electric Cooperative
SRMA	special recreation management area
SWPPP	stormwater pollution prevention plan
T	metric ton
TCM	Thompson Creek Mine
TCMC	Thompson Creek Mining Company
TDS	total dissolved solids
TES	Threatened, Endangered, and Sensitive
Tl	thallium
TMDL	total maximum daily load
TSF	tailings storage facility
TPI	total personal income
TSS	total suspended sediment
TWA	time-weighted average sound level
U	uranium
USACE	US Army Corps of Engineers
US	United States
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
V	vanadium
VOC	volatile organic compound
VQO	visual quality objective
VRM	visual resource management
WRSF	waste rock storage facility
WQS	water quality standard
WSA	wilderness study area
WUS	waters of the US
YOY	young of the year
Zn	zinc

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This final environmental impact statement (FEIS)/proposed resource management plan amendment (PRMPA) discloses the direct, indirect, and cumulative environmental effects that could result from a set of mine plan alternatives (Alternative M1 through Alternative M3) and an independent set of land disposal alternatives (Alternative L1 through Alternative L5). Of the alternatives under consideration, the agency-preferred alternatives are Alternative M2 (modified mining plan of operations [MMPO] as submitted to the agencies) and Alternative L2 (land exchange proposal).

PROPOSED (FEDERAL) ACTIONS

Thompson Creek Mining Company (TCMC) has submitted an MMPO to the Bureau of Land Management (BLM) Challis Field Office; US Forest Service, Salmon-Challis National Forest (SCNF); and other cooperating agencies for an expansion (extension of mine life) of the Thompson Creek molybdenum mine. In relation to the MMPO, TCMC has submitted an application to the US Army Corps of Engineers (USACE) for a permit under Section 404 of the Clean Water Act of 1972, as amended, to discharge dredged or fill materials into waters of the US (WUS). In addition, TCMC has submitted a separate proposal to exchange Federal land administered by the BLM for private lands owned by TCMC. Such exchange would require amendment of the Challis resource management plan (RMP) (BLM 1999). Therefore, the PRMPA is to identify the selected land in the land exchange proposal as suitable for disposal under the Federal Land Policy Management Act of 1976, as amended (FLPMA).

For the MMPO alternatives, the BLM will issue a decision regarding the storage of waste rock south of the open pit and long-term water management; the Forest Service will issue a decision regarding the storage of waste rock north of the open pit, expansion of the tailings storage facility (TSF), and re-alignment of a section of power line; and the USACE will issue a decision regarding a 404 permit for WUS that would be filled under an MMPO alternative. The BLM will also issue a decision regarding the land disposal alternatives (exchange, sale, no action), and a decision regarding the PRMPA (that would be required if a land disposal action alternative is to be implemented).

ADMINISTRATIVE REVIEW

Subsequent to the 30 day review period for the FEIS/PRMPA, the responsible officials from the BLM, Forest Service, and USACE will each prepare a Record of Decision (ROD) for the components of the project for which the officials have respective authority, and for which there are distinct objection processes (Section 1.6). The BLM and Forest Service will jointly release the FEIS and will distribute their RODs to all parties on the project mailing list, and on request to any interested party. The USACE ROD is an internal decision document provided to the proponent, but otherwise not normally distributed outside of the USACE.

BLM

The BLM decision for the MMPO and land disposal alternatives will be subject to administrative review (appeal) pursuant to 43 CFR 3809.800. The BLM decision on the RMP amendment will

follow the 60 day Governor's Consistency Review period and will also be subject to administrative review (protest) pursuant to 43 CFR 1610.5-2. An adversely affected party that intends to file an appeal must do so in writing with the BLM office where the decision was made; in this case the Challis Field Office for the MMPO, the Idaho Falls District for the land disposal, and the Idaho State Office for the RMP amendment. This notice of appeal must contain the information specified in 43 CFR 3809.802 and must be made within 30 calendar days after the date the decision was received, unless State Director review is requested (43 CFR 3809.801).

Forest Service

The Forest Service will issue a draft ROD subject to administrative review (objection) pursuant to 36 CFR 218 subparts A and B (Pre-Decisional Administrative Review). Objections will only be accepted from those who have previously submitted specific written comments regarding the proposed project during designated opportunities for public comment in accordance with §218.5(a). The first designated opportunity was the public scoping period. The second opportunity was the 90 day public comment period for the draft environmental impact statement. No further opportunities to obtain standing to object are anticipated for the project. Issues raised in objections must be based on previously submitted, timely, specific written comments regarding the proposal unless based on new information arising after the designated comment opportunities. A written objection must be submitted to the objection reviewing officer within 45 calendar days following the publication date of the legal notice of this opportunity to object in the Challis Messenger, Challis, Idaho. The objection must contain the minimum requirements specified in §218.8(d) and incorporation of documents by reference is permitted only as provided in §218.8(b). The publication date in the newspaper of record is the exclusive means for calculating the time to file an objection. If an objection is received on this project, a 45 day objection review period will begin.

Written objections must be submitted to Nora Rasure, Objection Reviewing Officer, Federal Building, 324 25th Street, Ogden, Utah 84401 (postal) or (801) 625-5277 (facsimile). Electronic comments must be submitted in a format such as an email message, plain text (.txt), rich text format (.rtf), and Word (.doc or .docx) to appeals-intermtn-regional-office@fs.fed.us. Please type "Thompson Creek Mine FEIS" in the subject line for e-mail messages and facsimile and include your mailing address and phone number.

At the end of the objection reviewing period the reviewing officer may consolidate objections and issue one response or may decide to issue a written response to each objection. The written response will be the final decision by the U.S. Department of Agriculture on the objections. Once the reviewing officer has issued the response to the objections and the responsible official has followed any instructions contained in the written response, or if no objections are received, the responsible official may sign the final revised ROD and implement the project without further legal notice of the decision. Interested and affected parties will be informed of the decision. The signing of the revised ROD in accordance with 40 CRF 1506.10, may occur on, but not before, the 5th business day following the end of the objection filing period.

USACE

The USACE decision on the 404 permit will be subject to the USACE appeal process dated March 28, 2000, "a District Engineer's decision on an approved jurisdictional determination, a

permit denial or a declined individual permit is subject to an administrative appeal by the affected party in accordance with the procedures and authorities contained in 33 CFR Part 331." The USACE 404 permit decision could only be administratively appealed by the TCMC.

MMPO ALTERNATIVES

The mine is currently permitted to complete Phase 7 (Alternative M1 – No Action). The MMPO submitted by TCMC would allow the completion of Phase 8 (Alternative M2 – MMPO as Submitted by TCMC). Alternative M3 (No Name Waste Rock Storage Facility [WRSF]) is generally the same as Alternative M2, except the No Name WRSF would be included within the overall configuration of the WRSFs and the Buckskin and Pat Hughes WRSFs would have correspondingly smaller final footprints. The core mine operations (e.g., molybdenum production rate and reclamation measures) are essentially the same in all of the MMPO alternatives.

Alternative M1 - No Action

Alternative M1 is TCMC completing mining operations per the approved mine plan of operations; i.e., through Phase 7. The existing operations (Section 2.1.1.) disturb 2,822.6 acres, mostly owned by TCMC (Table 2.1-2., Figure 2.1-1). Phase 7 ore production (from the base of the pit and entirely within the existing surface disturbance) would be completed by the end of 2016, with much of the reclamation (Section 2.1.1.8.) and post-reclamation monitoring (Table 2.1-4.) being completed 10 to 15 years later; reclamation would start at year 1 after mining and take 5 years, and monitoring and maintenance would occur from year 6 until year 15 (Section 2.1.1.9. includes information regarding adaptive management that may extend this period). Final surface disturbance would include the addition of waste rock to the WRSFs and tailings to the TSF generated during Phase 7 ore production.

Under Alternative M1 the mine would produce an additional 76 million pounds of molybdenum during Phase 7. Under Alternative M1 the TSF would contain approximately 235 million tons of tailings with a pre-reclamation embankment elevation of 7,646 feet (7,656 feet post-reclamation).

Active water treatment is not described in the approved reclamation plan for Alternative M1, but would have to be incorporated into the long term water management plan even if TCMC were to withdraw the proposed MMPO. Discharged water must meet all applicable laws and regulations, and active water treatment would be required. Therefore, active water treatment (described in Section 2.1.3.6.) is implicitly required.

Alternative M2 - MMPO as Submitted by TCMC

In December 2008 and January 2009 TCMC submitted an MMPO to the BLM, Forest Service, and other cooperating agencies. A revision to the MMPO was submitted in October 2009 (TCMC 2009). The MMPO describes Phase 8 mining (Alternative M2, the proposed action). The differences between this alternative and Alternative M1 are the following:

- The mine life would be 9 years longer;
- A section of power line would be relocated;
- The open pit would be deepened and widened to mine Phase 8 ore;
- The Buckskin and Pat Hughes WRSFs would be expanded and used to store Phase 8 waste rock;
- The TSF embankment would be raised and the TSF impoundment expanded to store the tailings produced from milling Phase 8 ore;
- The long-term water management plan would be modified because of the size and configuration of the Phase 8 facilities and the need for water treatment to ensure WQSs are met (Lorax 2012a); and
- Two additional groundwater cutoff walls would be installed in the Pat Hughes drainage.

Under Alternative M2 there would be additional surface disturbance on 110.0 acres of TCMC land and 385.6 acres of Federal lands as compared to Alternative M1 (Figure 2.1-4.,Table 2.1-5.,Table 2.1-6). Of this disturbance, 3.39 acres of wetlands and 10,641 linear feet of stream channel designated as WUS would be subject to a 404 permit from the USACE.

Transportation, Access, and Power

Under Alternative M2 4,900 feet of an existing 24.9 kV power line on National Forest System land ("Phase 8 power line," Figure 2.1-4.) would be relocated on National Forest System land in the area northeast of the open pit. The relocation would be necessary because of expansion of the open pit. The relocated utility corridor would include 21.9 acres of surface disturbance.

Mining operations

Under Alternative M2 molybdenum production would continue to 2025 (instead of 2016 under Alternative M1), with most reclamation completed 10 to 15 years later (Section 2.1.1.9. includes information regarding adaptive management that may extend this period). The mine would produce an additional 131 million pounds of molybdenum as compared to Alternative M1.

Waste rock storage facilities

Under Alternative M2 263.5 million tons of waste rock would be removed and stored in the Buckskin (upper Buckskin) (107.7 million tons) and Pat Hughes (lower Pat Hughes) (155.8 million tons) WRSFs (Figure 2.1-4). The expansion of the WRSFs would occur on both private and Federal land (Table 2.1-4). The Pat Hughes sediment control pond (sedimentation pond) would be relocated to the base of the final toe of the Pat Hughes WRSF.

Mill and tailings operations

Milling the Phase 8 East and Phase 8 West ore would require additional tailings storage capacity, which would be accomplished by raising and partially re-aligning the TSF embankment crest compared to that at the end of Phase 7 (Figure 2.1-4). This would increase the capacity of the

TSF by 100 to 125 million tons, which would provide adequate space for the tailings produced during Phase 8. The TSF is permitted to store approximately 240 million tons of tailings through the end of Phase 7 (Alternative M1), and approximately 335 million tons at the end of Phase 8 (Alternative M2). The TSF embankment would be raised to 7,742 feet before reclamation (from 7,646 feet at the end of Phase 7) to provide sufficient storage in the upgradient impoundment.

Environmental controls and monitoring

TCMC would utilize the same environmental controls and monitoring under Alternative M2 as would be used under Alternative M1 (Section 2.2.1). Additionally, an adaptive groundwater management plan (Lorax 2012b) was developed that includes the water management strategies and mitigation necessary to minimize the MMPO effects to water resources. Adaptive management strategies (Section 2.1.1.9.) would allow for adjustment of operating procedures, mitigation measures, and/or monitoring in response to key resource concerns identified through monitoring.

In order to comply with the MBTA and other direction (Section 1.9.6) and the BGEPA (Section 1.9.7), the following measures would be implemented during all habitat–clearing activities, particularly timber harvest, power line relocation, and pipeline construction:

1) Timber harvest, power line relocation, and pipeline construction would be scheduled for outside of the general nesting season (April 15 – July 31), or as late in the nesting season as possible.
2) Migratory bird habitat within planned disturbance areas would be grubbed (habitat removal or rendering habitat unsuitable for nesting) to the maximum extent practicable during winter prior to construction, when migratory birds are least likely to be present, and to prevent migratory birds from using the habitat and being encountered during pre-construction surveys.
3) Activities would be avoided during the general nesting season (April 15 – July 31). Prior to activities that must take place during the general nesting season, TCMC would perform surveys for migratory bird nests to the maximum extent possible within the disturbance areas, including for sensitive species.
4) Prior to any habitat removal during which raptors may be nesting (February 1 – August 31), TCMC would also perform surveys for raptors, including for sensitive species.
5) If an active nest is found, the nest and a surrounding buffer area would be avoided until birds have fledged. An exception to this restriction may be granted by the BLM due to natural screening or other factors that may reduce noise impacts.
6) Note that bald eagles may be nesting as early as January. If an active bald eagle nest is found, the regional USFWS office and BLM should be contacted immediately as any disturbance of bald eagles is a violation of the BGEPA.

Under the action alternatives, construction in stream channels would occur during low flows, and the channels and banks would be stabilized against erosion as part of the initial construction.

Reclamation

Reclamation would generally be the same for Alternative M2 (Phase 8) as it would be for Alternative M1 (Phase 7) (Section 2.1.1.8.), except as summarized in this section. Note that the active water treatment described in this section is not described in the approved reclamation plan for Alternative M1, but would have to be incorporated into the long term water management plan even if TCMC were to withdraw the proposed MMPO. Discharged water must meet all applicable laws and regulations, and active water treatment would be required. Therefore, active water treatment is implicitly required.

At the end of Phase 8, the Buckskin WRSF would consist of an upper and middle bench between 8,200 to 7,600 feet and a lower bench at 7,600 to 6,650 feet elevation. The Pat Hughes WRSF would have four benches at 7,850 to 7,350 feet; 7,350 to 7,000 feet; 7,000 to 6,750 feet; and 6,750 to 6,250 feet elevation. The reclamation of the TSF under Alternative M2 would be the same as that under Alternative M1, except the footprint of the facility would be slightly larger, the final reclaimed height of the embankment would be 7,752 feet instead of 7,656 feet, and the spillway would be constructed through native rock at an elevation of 7,722 feet.

TCMC would either construct a long-term water treatment facility or modify the existing process water treatment plant. TCMC would also, on a long-term basis, collect water from the WRSFs and TSF and route this water to the open pit and eventually to the water treatment facility. These inputs would inundate the pit to an elevation of 7,030 feet to minimize oxidation of the pit walls. The water level in the pit would be maintained at this elevation to avoid the potential of water leaving the southeast end of the pit via an exploration adit (sealed), and to maintain a cone of depression, i.e., keep groundwater flowing into the pit to minimize the potential for mine-affected waters to affect off-site groundwater. The cutoff walls, which would be installed during operations, would remain in place throughout reclamation.

The sedimentation ponds below the WRSFs and the seepage return dam and pump-back sump/station below the TSF would be maintained as permanent features to collect drainage from these facilities, which would be pumped through pipelines to the open pit, and eventually to the water treatment plant. The treated water would then be discharged via pipelines to either Outfall 002 at the confluence of Pat Hughes Creek and Thompson Creek, or Outfall 005 near the confluence of Thompson Creek and the Salmon River (Figure 2.1-1). The difference under Alternative M2 in the post-reclamation monitoring as compared to that under Alternative M1 is that some monitoring could continue for longer durations (Table 2.1-7).

Alternative M3 - No Name Waste Rock Storage Facility

This alternative is similar to Alternative M2, except that the No Name WRSF would contain approximately 115 million tons of waste rock on 232.9 acres of currently undisturbed BLM land. The WRSF would include a downgradient sedimentation pond. The location is economically favorable for waste rock storage due to the proximity of the No Name drainage to the open pit and a level to downgradient loaded haul. Accordingly, under Alternative M3, less waste rock would be placed in the Buckskin and possibly the Pat Hughes WRSFs, and these WRSFs would have smaller overall footprints than under Alternative M2 (Figure 2.1-5., Table 2.1-8). Under Alternative M3, compared to Alternative M2, there would be an additional 0.05 acres of

disturbance in wetlands and an additional 5,563 linear feet of designated waters of the US subject to a 404 permit from the USACE.

LAND DISPOSAL ALTERNATIVES

Alternative L1 - No Action

The BLM would not approve the land exchange proposal or any of the other land disposal alternatives, and would not amend the Challis RMP to identify the selected land as suitable for disposal under the FLPMA (Section 1.4). There would therefore be no change to the current land status: the Broken Wing Ranch (813 acres) and Garden Creek property (80 acres) would remain privately owned, and the selected land (~ 5,100 acres) would remain as BLM land (Figure 1.2-1., Figure 1.3-1). Since none of the MMPO alternatives are affected by any of the land disposal alternatives, under Alternative L1 the mine would continue operations on a combination of private, BLM, and National Forest System land as described in MMPO Alternative M1, M2, or M3 depending upon the agency decisions for the MMPO alternatives (Section 2.1).

Alternative L2 - Land Exchange Proposal

The BLM would amend the Challis RMP to identify the selected land as suitable for disposal under the FLPMA, and would approve the land exchange proposal. TCMC would thus acquire a tract of BLM (selected) land, including both surface and mineral estates on up to approximately 5,100 acres, at the mine site. The US would acquire two tracts of privately owned (offered) land, including both surface and mineral estates on up to approximately 900 acres that would be administered by the BLM. The selected land comprises all Federal land in Sections 1 to 4, 9 to 12, T. 11 N., R. 16 E. and Sections 5 to 8, T. 11 N., R. 17 E., B.M. in Custer County, Idaho (Figure 1.2-1., Figure 2.2-1).

However, as an example of the minor adjustments that might occur, the BLM would exclude the Federal land east of the centerline of S.[1] Creek Road from the selected land. Therefore, the *selected land* hereafter refers to such reduced area ("modified east boundary," ~ 5,100 acres) (Figure 2.2-1., dashed red line).

The offered lands consist of two tracts owned by TCMC: the Broken Wing Ranch, 6 miles northeast of Clayton in Custer County, Idaho; and the Garden Creek property, 16 miles southeast of Pocatello in Bannock County, Idaho (Figure 2.2-2). Descriptions of the selected and offered lands and the reasonably foreseeable uses of the lands are provided below. A description of provisions that would apply to all land disposal action alternatives is also provided below and in Section 2.2.7. Alternative L2-B is a sub-alternative to Alternative L2 specific to the Broken Wing Ranch (Section 2.2.2.2).

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[1] *Squaw Creek* is an official place name in Custer County, and appears in numerous published documents including US Geological Survey topographic maps. The name was established by the US Board of Geographic Names to maintain uniform geographic name usage throughout the Federal Government. However, the word *Squaw* is offensive to some people including the Shoshone-Bannock Tribes. Therefore, *Squaw Creek* is hereafter referred to in the main text as *S. Creek*.

Selected land

The selected land (~ 5,100 acres) is either undeveloped, forested land or is already used for mining. All of the land is covered by mining claims owned by TCMC. Mining currently disturbs 451 acres of the selected land including a widely distributed network of sedimentation ponds, access roads, and power line and pipeline corridors (Figure 2.2-1., Table 2.1-3). The additional disturbance of the selected land under the MMPO alternatives would be 200.1 acres under Alternative M2, and 417.9 acres under Alternative M3. There would not be any additional disturbance of the selected land under Alternative M1.

TCMC has stated that it has no current intention to use any of the selected land for mining, including mineral exploration, apart from the activities identified in the MMPO alternatives above. That is, TCMC would not mine differently under any of the MMPO alternatives if the selected land were owned by TCMC, or if the selected land continued to be Federal land. In addition, internal and public scoping and a mineral potential report (Gardner 2008) have not identified any mining activities that would reasonably be expected to occur on the selected land, apart from those identified in the MMPO alternatives. TCMC does not have post-reclamation development plans for the selected land should TCMC acquire it. In addition, water treatment activities on some of the land could occur many decades after mining ceases in 2025.

Broken Wing Ranch

The Broken Wing Ranch consists of 813 acres of irrigated agricultural fields, rangeland, ranch structures, and a historic homestead in Custer County. The ranch includes 4.4 miles of Salmon River frontage as well as various streams including Lyon Creek. In addition to the Resource Advisory Committee (RAC)-recommended management of the ranch (Alternative L2), a sub-alternative for ranch management has been developed (Alternative L2-B).

Alternative L2

The ranch would be managed according to the recommendations of the BLM Idaho Falls District RAC (BLM 2009b), which categorizes the ranch into nine management parcels with specific management recommendations for each parcel. However, because the nine management parcels do not all correspond to surveyed areas of land, the management parcels are assigned to seven surveyed subparcels (BWR-1 through BWR-7) (Figure 2.2-3., Table 2.2-1). In addition, the BLM has developed a conceptual restoration plan for the lower 1,850 feet of Lyon Creek to address removal of an on-channel impoundment (Lyon Creek pond), consolidation of four stream crossings, as well as improved fish passage, fish habitat, channel stability, and riparian vegetation. Final designs would be made, project funding would be sought, and the BLM would implement the plan if the US acquires that portion of the ranch.

The BLM policy is to avoid obtaining structures not necessary for the BLM mission. Therefore, prior to the land exchange, TCMC may donate to Custer County the Lyon Creek Bridge, as well as the Lyon Creek and Sink Creek ranch houses/outbuildings. Alternatively, prior to the land exchange, TCMC may sell the Lyon Creek ranch house/outbuildings to a private party and/or remove the Sink Creek ranch house, i.e., no Sink Creek parcel donated to the county. The donation or sale of the Lyon Creek and Sink Creek structures would include 2.5 acres (county

minimum parcel size) of land around each house, and appropriate easements for access. The historical structures on the ranch would be acquired by the BLM.

The BLM would make the ranch available for grazing (~ 800 acres of irrigated fields and rangeland), and would authorize grazing for 27 animal unit months in the Lyon Creek "Graham Field" meadow. For the rest of the irrigated fields on the ranch, the potential stocking rate would be 3,040 AUMs (Table 2.2-1., Table 2.2-2).

The non-motorized access in the Lyon Creek drainage would begin at or near the Lyon Creek ford by the Lyon Creek ranch house. Firearm discharge safety zones would be established around the two ranch houses, but hunting and shooting would otherwise (generally) be allowed in the same manner as is allowed on other Federal lands. However, the public would not be allowed in the cultivated fields during the growing season (e.g., mid-April through mid-October) to avoid damage to crops. The dilapidated trailer on the east side of the Salmon River would be demolished and removed, and the driveway and former trailer site would be used for parking and river access.

Alternative L2-B

Alternative L2-B would be the same management as under Alternative L2, except: 1) there would be no grazing at the ranch (on the fenced fields), 2) the cultivated fields would be actively converted to native vegetation, and 3) motorized access would be allowed in the Lyon Creek drainage to near the western edge of BWR-1 (where there are existing areas to park and turn around longer vehicles). The irrigated portions of the ranch (~ 400 acres) would actively be converted to native vegetation, except for the Lyon Creek meadow. The conversion would require approximately 3 years, and would consist of having a full-time ranch manager plow and/or use herbicide to kill the current vegetation in the cultivated fields and roads, seed the fields with a native seed mixture, operate the existing irrigation systems, and manage an aggressive invasive and non-native plant ("weed") eradication program. After 3 years the manager would also remove all of the ranch equipment except the fences. There would be a high probability – but not certainty – of successful conversion, i.e., self-sustaining native vegetation, no excessive soil erosion/loss, and no major weed infestations.

Garden Creek property

The Garden Creek property consists of 80 acres of undeveloped, forested land southeast of Pocatello in Bannock County (Figure 2.2-2). Under Alternative L2 the Garden Creek property would be managed under the BLM Pocatello RMP with no site-specific management provisions for the property.

Alternative L3 - Land Sale

The BLM would amend the Challis RMP to identify the selected land as suitable for disposal by sale under Section 203 of the FLPMA. The US would not obtain any of the offered lands. The selected land would be sold by a direct (non-competitive) sale to TCMC, a modified competitive sale (TCMC would be identified as the bidder authorized to meet the high bid), or a competitive sale (the highest bidder would receive title to the property). In the first case the sale would be at

the appraised fair market value pursuant to Section 203 of the FLPMA and all other applicable laws, regulations (e.g. 43 CFR 2710).

Alternative L4 - Reduced Area Land Exchange, Fee Simple

The BLM would amend the Challis RMP to identify approximately 3,600 acres of the selected land (rather than ~ 5,100 acres) as suitable for disposal, and the BLM would approve a land exchange in which TCMC would acquire approximately 3,600 acres of the selected land (Figure 2.2-4). The US would correspondingly acquire an equivalent fair market value (~ 30 % less by area) of the offered lands. To balance the reduced value of the selected land, the US would not acquire the Garden Creek property and/or lower priority portions of the Broken Wing Ranch.

Alternative L5 - Reduced Area Land Exchange, Easement

The BLM would amend the Challis RMP to identify all of the selected land (~ 5,100 acres) as suitable for disposal under the FLPMA. The BLM would approve the land exchange proposal, but with approximately 1,500 acres of the selected land protected by a conservation easement held by the BLM (Figure 2.2-5). This alternative, a variation of Alternative L4, would result in a more compact land jurisdiction pattern in the vicinity of the mine, and would protect a block of the selected land on which mining activities are not foreseen and would not occur under the MMPO alternatives.

TCMC would therefore acquire the selected land, and the US would acquire most of the offered lands. However, unlike Alternative L2, approximately 1,500 acres of the selected land would be protected by a conservation easement requiring the land to remain essentially in its current condition, e.g., no residential development or mining. The lesser fair market value of the offered lands due to the easement would require eliminating either the Garden Creek parcel and/or certain subparcels of the Broken Wing Ranch from the land exchange, but to a lesser extent than under Alternative L4. That is, compared to Alternative L2, the US would acquire approximately 30 percent less (by fair market value) of the offered lands under Alternative L4 and approximately 10 percent less under Alternative L5. The offered lands that the US would acquire would be administered by the BLM as described in Alternative L2 or Alternative L2-B (Section 2.2.2).

Land Disposal Action Alternative Provisions

The seven following provisions would occur at or before title transfer under all of the land disposal action alternatives, unless under Alternative L3 the selected land was sold to a party other than TCMC. In such case, only the seventh provision would occur.

1. *South Butte Road Access*
   TCMC would grant public access along two sections of the South Butte Road, which passes through private property owned by TCMC (Figure 2.2-6). This grant would formalize the public access that TCMC has allowed on the road since 1981.

2. *Twin Apex Property Access*
   The BLM would grant the owners of the Twin Apex property access to their property via the Bruno Creek Road, and TCMC would modify its exclusive right-of-way (granted by the BLM) for Bruno Creek Road to allow such access (Figure 2.2-6).

3. *Thompson Creek Road Access*
   The existing public access along the upper Thompson Creek Road would be retained by the US (Figure 2.2-7).

4. *Management for Big Game Including Provisions for Public Access*
   TCMC would pursue a donated Access Yes agreement through the IDFG Access Yes Program to allow non-motorized access for private or commercial hunters and anglers, as well as general recreationalists to the selected land with the exception of the land that drains into Bruno Creek, Buckskin Creek, Pat Hughes Creek and Cherry Creek (Figure 2.2-8).

5. *S. Creek Grazing Allotment, Saturday Mountain Pasture*
   TCMC would grant administrative access to the BLM and its permittees to use roads on property owned by TCMC to reach the Saturday Mountain Pasture (Figure 2.2-6).

6. *Challis East Subdivision Trail Access*
   TCMC would grant public access (motorized or non-motorized) via a trail within a 20 foot wide easement along one side of the perimeter of property owned by TCMC in the Challis East Subdivision provided that trail access is also acceptable to the subdivision property owners and/or the local government. The trail would provide a connection to the Lombard Trail around Blue Mountain, and could ultimately be part of a new trail system envisioned to the Salmon River (Figure 2.2-9).

7. *Thompson Creek and S. Creek Conservation Easement*
   TCMC would grant the BLM a conservation easement for the following areas: 1) the area of the selected land within ⅛ mile of the centerline of Thompson Creek (~ 4 miles of stream length, ~ 280 acres), and 2) the area of the selected land within ⅛ mile of the centerline of the portions of S. Creek within the selected land (~ ½ mile of stream length, ~ 70 acres) (Figure 2.2-1). In the S. Creek portion of the easement area, the easement would prohibit subdivision/residential development and protect the Bruno Creek fossil locality. In the Thompson Creek portion of the easement area, the easement would prohibit subdivision/residential development as well as all other activities contrary to the purpose of the easement.

   The easement would allow for the use, repair, and replacement of the existing infrastructure such as roads, power lines, pipelines, irrigation ditches, etc. within the easement area, and for unforeseen mine operations (e.g., extensions of power lines or pipelines for long-term water management) which would not materially degrade the riparian values for which the easement would be intended to protect. As livestock grazing is not currently permitted along Thompson Creek on BLM land, the easement would prohibit grazing within the Thompson Creek portion of the easement area.

ENVIRONMENTAL EFFECTS

The environmental effects of the MMPO and land disposal alternatives were evaluated and compared in detail in Chapter 4 of the FEIS. A listing of the primary environmental effects of the MMPO and land disposal action alternatives is provided in Tables ES-1 and ES-2, respectively. Effects related to the offered lands would not occur under Alternative L3 because the offered lands would not change jurisdictions.

Table ES-1. Effects comparison, MMPO alternatives.

Indicator	Alternative M1	Alternative M2	Alternative M3
GEOLOGIC RESOURCES AND GEOTECHNICAL ISSUES			
Molybdenum production	Increase in world molybdenum production of 73 million pounds (short-term, moderate effect)	Increase in world molybdenum production of 204 million pounds (short-term, moderate effect)	Same as Alternative M2
Molybdenum reserves	Decrease in world molybdenum reserves by 73 million pounds (short-term, minor effect)	Decrease in world molybdenum reserves by 204 million pounds (short-term, minor effect)	Same as Alternative M2
Paleontological sites	No change to existing conditions	No change to existing conditions	No change to existing conditions
SOIL RESOURCES			
Soil productivity	No change to existing conditions	384.9 acres of permanent effects (negligible to moderate) and 112.1 acres of temporary effects (negligible to moderate)	526.5 acres of permanent effects (negligible to moderate) and 112.1 acres of temporary effects (negligible to moderate)
VEGETATION, FOREST RESOURCES, AND INVASIVE AND NON-NATIVE PLANTS			
Area of special status[1] plant habitat disturbed	No change to existing conditions	497.0 acres of suitable sensitive plant habitat disturbed (no records of occurrence); may affect individual plants but would not cause a trend towards listing	640.6 acres of suitable sensitive plant habitat disturbed (no records of occurrence); may affect individual plants but would not cause a trend towards listing
Area of forest habitat disturbed	No change to existing conditions	391.0 acres forest habitat (2,548 mbf)[2] harvested (long-term, moderate effect)	487.2 acres forest habitat (3,169 mbf) harvested (long-term, moderate effect)
Change in carbon sequestration	No change to existing conditions	No effect on existing conditions	No change to existing conditions
RANGE RESOURCES			
Change in AUMs[3]	No change to existing conditions	4 % decrease (long-term, minor effect)	6 % decrease (long-term, minor effect)

Indicator	Alternative M1	Alternative M2	Alternative M3
WATER RESOURCES			
Water quality - turbidity, concentrations of suspended sediment, and COCs	During mining/after cutoff wall installation: decreased concentrations of most constituents in Thompson Creek; increased concentrations of some constituents over time would still meet WQSs[4] for all parameters under conditions analyzed After mining: increased concentrations of some constituents in S. Creek, but would be within WQSs except for cadmium for the conservative upper estimates/7Q10 low flow condition; discharge from Outfall 005 to the Salmon River would need to meet all NPDES permit limits	During mining/after cutoff wall installation: decreased concentrations of most constituents in Thompson Creek; increased concentrations of some constituents over time would meet WQSs for all parameters with the exception of copper for the conservative upper estimate/7Q10 low flow condition (long-term, moderate effect); negligible effect to Thompson Creek, Bruno Creek, and S. Creek from sediment delivery After mining: increased concentrations of some constituents in S. Creek; would be within WQSs except for cadmium for the conservative upper estimates/7Q10 low flow condition; discharge from Outfall 005 to the Salmon River would need to meet all NPDES permit limits	Same as Alternative M2
Water quantity - discharge	During mining/after cutoff wall installation: negligible or minor reduction in flow in Thompson Creek After mining: negligible effects to flow in Bruno Creek and S. Creek; negligible to minor effects to flow in Salmon River (depending on flow) due to cessation of removal of water for mine processes	During mining: negligible to minor reduction in flow in Thompson Creek and S. Creek from cutoff walls After mining: negligible effects to flow in Bruno Creek and S. Creek; negligible to minor effects to flow in Salmon River (depending on flow) due to cessation of removal of water for mine processes	Same as Alternative M2

Indicator	Alternative M1	Alternative M2	Alternative M3
WILDLIFE RESOURCES			
Area of disturbance to high value wildlife habitat	No change to existing conditions	Decrease of 413 acres of habitat with long-term, negligible to minor effect on sensitive wildlife species; long-term, minor effect on wide-ranging species; short-term, minor effect to winter range; negligible effect on migration Unintentional take, occurring when active migratory bird or raptor nests are either not found during surveys (i.e., disturbed unintentionally), or cannot be avoided, would be a short-term, minor effect and would not have any measurable effects on migratory bird populations	Decrease of 647 acres of habitat with long-term, negligible to minor effect on sensitive wildlife species; long-term, minor effect on wide-ranging species; short-term, minor effect to winter range; negligible effect on migration. Unintentional take, occurring when active migratory bird or raptor nests are either not found during surveys (i.e., disturbed unintentionally), or cannot be avoided, would be a short-term, minor effect and would not have any measurable effects on migratory bird populations
Water quantity/quality effects on wildlife	Negligible effects from changes to water quantity; negligible effect to birds from ingestion of pit water	Negligible effects from changes to water quality; negligible effects to birds from ingestion of pit water	Same as Alternative M2
Noise disturbance	No change to existing conditions	Negligible (temporary) effect during construction of WRSFs	Same as Alternative M2
Wildlife mortality from traffic (road kill)	No change to existing conditions	No effect on existing road mortality, but 9 additional years of effect of mine traffic on road mortality	Same as Alternative M2
FISH AND AQUATIC RESOURCES			
Aquatic habitat	Negligible effect to existing conditions	Negligible effect to aquatic habitat in Salmon River; long-term, moderate effect to aquatic habitat in Thompson Creek and S. Creek	Same as Alternative M2

Indicator	Alternative M1	Alternative M2	Alternative M3
Fish populations	Negligible effect to existing conditions	Negligible effect to fish populations in Salmon River; long-term, moderate effect to aquatic habitat in Thompson Creek; long-term, minor to moderate effects to fish populations in S. Creek	Same as Alternative M2
Bioaccumulation	Negligible effect to existing conditions	Negligible chance of bioaccumulation of selenium in Thompson Creek	Same as Alternative M2
Macroinvertebrate organisms	Negligible (selenium bioaccumulation) to minor (reduced overall taxa richness) effects on macroinvertebrate organisms	Minor effects to Thompson Creek and S. Creek macroinvertebrate organisms for the best estimates; moderate effects for the upper estimates	Same as Alternative M2
WETLANDS, FLOODPLAINS, AND RIPARIAN AREAS			
Area of wetlands	No change to existing conditions	Fill or burial of 3.39 acres of jurisdictional wetlands (0.43 acre filled by Phase 8, 2.96 acres filled by reclamation); mitigation would result in no net effect	Fill or burial of 3.44 acres of jurisdictional wetlands (0.48 acre filled by Phase 8, 2.96 acres filled by reclamation); mitigation would result in no net effect
Length of stream channel	No change to existing conditions	10,641 feet (10 % of the stream channel) of WUS[5] filled (4,781 feet filled by Phase 8, 5,860 feet filled by reclamation); mitigation would result in no net effect	16,247 feet (50 % of the stream channel) of WUS filled (10,387 feet filled by Phase 8, 5,860 feet filled by reclamation); mitigation would result in no net effect
AIR QUALITY, NOISE, AND CLIMATE CHANGE			
Quantities of air pollutants	No change to existing conditions	No effect to existing quantity of air pollutants, but the existing quantity of air pollutants related to the mine would persist for an additional 9 years	Same as Alternative M2
Noise levels	No change to existing conditions	No effect to existing noise levels but the current noise levels related to the mine would persist for another 9 years	Same as Alternative M2

Indicator	Alternative M1	Alternative M2	Alternative M3
Climate change	No change to existing conditions	No effect to climate change and no effect of climate change to the project	No effect to climate change and no effect of climate change to the project
VISUAL (AESTHETIC) RESOURCES			
VQO and VRM classification	No change to existing conditions	The visual disturbance would meet the current visual classifications at all KOPs[6] except KOP 6; the Pat Hughes WRSF would not meet the VRM Class II objective (long-term, moderate to major effect)	The visual disturbance would meet the current visual classifications at all KOPs except KOP 6 and KOP 2; neither the Pat Hughes nor No Name WRSF would meet the VRM Class II objective (long-term, moderate to major effect)
LAND USE AND RECREATION			
Recreational access	No change to existing conditions	Negligible effect to recreational access	Negligible effect to recreational access
ROS[7] classification	No change to existing conditions	No change to ROS classification	No change to ROS classification
Special Designations	No change to existing conditions	Negligible effect to Challis ERMA	Negligible effect to Challis ERMA
SOCIOECONOMIC FACTORS			
Local economy	No change to existing conditions	No change to the current local economy, except the economic effects of the mine on the local economy would extend an additional 9 years	Same as Alternative M2
Molybdenum supply and prices	No change to existing conditions	No effect to current molybdenum supply or prices, except the effects of the mine on supply and prices would extend an additional 9 years	Same as Alternative M2
Financial risk to agencies and taxpayers	Financial risk would be mitigated by financial guarantees	Financial risk would be mitigated by financial guarantees	Financial risk would be mitigated by financial guarantees

Indicator	Alternative M1	Alternative M2	Alternative M3
TRIBAL TREATY RIGHTS AND INTERESTS			
Area of unoccupied Federal land	No change to existing conditions	< 1 % decrease (minor, permanent, adverse)	Same as Alternative M2
Cultural resource sites	No change to existing conditions	Site 10CR758 (eligible for the NRHP) would be partially inundated by the expansion of the TSF (long-term, adverse effect)	Same as Alternative M2
Effects to natural resources utilized by tribes	Summarized in the sections for the other resources	Summarized in the sections for the other resources	Summarized in the sections for the other resources
CULTURAL RESOURCES			
Cultural resource sites	No change to existing conditions	Site 10CR758 (eligible for the NRHP) would be partially inundated by the expansion of the TSF (long-term, adverse effect)	Same as Alternative M2
TRANSPORTATION, ACCESS, AND PUBLIC SAFETY			
Molybdenum spills due to vehicle accidents	No change to existing conditions	No effect to current threat of spills, but the current potential for spills would extend additional 9 years	Same as Alternative M2
HAZARDOUS MATERIALS AND SOLID WASTE			
Threat of releases of hazardous materials and petroleum products	No change to existing conditions	No effect to threat of releases, but the current potential for releases would extend additional 9 years	Same as Alternative M2

[1] Threatened, Endangered, Proposed, Candidate, and Sensitive (special status)
[2] mbf = 1,000 board feet
[3] animal unit months (AUMs)
[4] water quality standards (WQSs)
[5] waters of the US (WUS)
[6] key observation point (KOP)
[7] recreational opportunity spectrum (ROS)

Table ES-2. Effects comparison, land disposal alternatives.

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
GEOLOGIC RESOURCES AND GEOTECHNICAL ISSUES					
Saleable, locatable or leasable mineral availability	No change to existing conditions	Negligible effect to mineral availability	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2
SOIL RESOURCES					
Acres or % of area of soil compaction, change to productivity, erosion potential	No change to existing conditions	No effects to the selected land. Small areas of soil at ranch could become compacted from parking areas, campgrounds. Under L2-B ~ 52 % of the soil at the ranch would be altered by the conversion to native vegetation.	No effects to the selected or offered lands	No effects to the selected land. Effects to the offered lands would be the same as Alternative L2, except land removed from the transaction would not be subject to potential limited soil compaction from development.	No effects to the selected land. Effects to the offered lands would be the same as Alternative L4.
VEGETATION, FOREST RESOURCES, AND INVASIVE AND NON-NATIVE PLANTS					
Area of special status plant habitat	No change to existing conditions	365 acres of occupied or potentially occupied special status plant habitat on ranch would come under BLM administration	No change to existing conditions	Same as Alternative L2, except the area would change to achieve equal value	Same as Alternative L2, except the area would change to achieve equal value
RANGE RESOURCES					
Area of suitable grazing lands	No change to existing conditions	Decrease of 80 % of suitable grazing lands (major, long term) on selected land	Same as Alternative L2	Decrease of 71 % of suitable grazing lands (major, long term) on selected land	Same as Alternative L2

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
Change in AUMs	No change to existing conditions	Decrease of 80 % of AUMs (major, long term) on selected land	Same as Alternative L2	Decrease of 69 % of AUMs (major, long term) on selected land	Same as Alternative L2
WATER RESOURCES					
Water quality (no indicators)	No change to existing conditions	No effect to selected land or Garden Creek property Negligible effect to Salmon River due to sediment delivery from BLM-recommended management such as campground or boat launch; riparian improvements would cause negligible reduction in sediment delivery to Salmon River Restoration of Lyon Creek would restore a more normal flow with less erosion and sediment input into the lower 1,850 ft. of Lyon Creek (long-term, moderate effect)	No change to existing conditions	Effects would be the same as Alternative L2, except the effects related to subparcels (~ 30 % less by fair market value compared to Alternative L2) that would not be acquired by the US would not occur	Effects would be the same as Alternative L2, except the effects related to subparcels (~ 10 % less by fair market value compared to Alternative L2) that would not be acquired by the US would not occur

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
Water quantity (change in flow)	No change to existing conditions	No effect to selected land or Garden Creek property No change to flow or volume associated with water rights on Broken Wing Ranch	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
WILDLIFE RESOURCES					
Area of special status wildlife habitat	No change to existing conditions	No change to existing conditions	No change to existing conditions	No change to existing conditions	No change to existing conditions
Hunting pressure	No change to existing conditions	Increased hunting pressure (long-term, minor effect)	No change to existing conditions	Increased hunting pressure (long-term, minor effect)	Increased hunting pressure (long-term, minor effect)
FISH AND AQUATIC RESOURCES					
Amount of suitable habitat	No change to existing conditions	No effect to Garden Creek property; net increase in both suitable habitat and designated critical habitat under BLM jurisdiction Restoration of Lyon Creek would decrease water temperatures and improve fish habitat and thermal refugia	Decrease of 5.3 miles of occupied designated critical habitat under BLM jurisdiction; however, no new disturbance would occur adjacent to streams	Same as Alternative L2	Same as Alternative L2

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
Habitat quality	No change to existing conditions	No effect to selected land or Garden Creek property; long-term, moderate beneficial effect to aquatic habitat in Lyon Creek and Salmon River	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
WETLANDS, FLOODPLAINS, AND RIPARIAN AREAS					
Area of wetlands	No change to existing conditions	49.69 acres of wetlands would leave Federal jurisdiction; 37.68 acres of wetlands would enter Federal jurisdiction; improvements to riparian areas along Salmon River on the ranch	49.69 acres of wetlands would leave Federal jurisdiction	21.72 acres would leave Federal jurisdiction; unknown area would enter Federal jurisdiction, but would probably be less than 37.68 acres	Same as Alternative L4, except slightly more wetlands would probably enter Federal jurisdiction
AIR QUALITY, NOISE, AND CLIMATE CHANGE					
Change in noise at ranch and in Lyon Creek	No change to existing conditions	Minor increase in noise due to agricultural activities	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
VISUAL (AESTHETIC) RESOURCES					
Changes in scenery	No change to existing conditions	Subtle visual changes to ranch due to BLM administration	No change to existing conditions	Same as Alternative L2	Same as Alternative L2

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
LAND USE AND RECREATION					
Area of Federal land	No change to existing conditions	Net decrease of 4,300 acres of Federal land in the BLM Challis Field Office area (negligible effect); net increase of 82 acres in the BLM Pocatello Field Office area (negligible effect)	Net decrease of 5,100 acres of Federal land in the BLM Challis Field Office area (negligible effect)	Decrease of 3,600 acres of Federal land in the BLM Challis Field Office area (selected land); increase of 895 acres less ~ 30 % by fair market value in The BLM Challis and Pocatello Field Office areas	Decrease of 5,100 acres of Federal land in the BLM Challis Field Office area (selected land); increase of 895 acres less ~ 10 % by fair market value in the BLM Challis and Pocatello Field Office areas
Recreational use	No change to existing conditions	Negligible effects due to reduced access to some portions of selected land; public recreation opportunities increased on ranch and Garden Creek property	Same as Alternative L2	Negligible effects due to reduced access to some portions of selected land; public recreation opportunities increased on ranch but less than Alternative L2	Negligible effects due to reduced access to some portions of selected land; public recreation opportunities increased on ranch, less than Alternative L2 but more than Alternative L4
SOCIOECONOMIC FACTORS					
Tax revenue	No change to existing conditions	Negligible effects to tax revenue	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2
BLM revenue	No change to existing conditions	Negligible effects to BLM revenue	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2
TRIBAL TREATY RIGHTS AND INTERESTS					
Area of unoccupied Federal land	No change to existing conditions	< 1 % decrease in unoccupied Federal land (minor, permanent, adverse)	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
CULTURAL RESOURCES					
Cultural resource sites	No change to existing conditions	5 NRHP-eligible and 2 potentially eligible sites would come under BLM management (on ranch)	No change to existing conditions	The effect to cultural resource sites would be similar to Alternative L2, but the number of sites would depend on which subparcels were acquired by the US	The effect to cultural resource sites would be similar, but the number of sites would depend on which subparcels were acquired by the US
TRANSPORTATION, ACCESS, AND PUBLIC SAFETY					
Access to grazing allotments	No effect on existing conditions	Access to grazing would increase	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
HAZARDOUS MATERIALS AND HAZARDOUS AND SOLID WASTE					
Chance for releases or dumping on ranch	No effect on existing conditions	Minor increase in potential for dumping (because public land)	No change to existing conditions	Same as Alternative L2	Same as Alternative L2

CHAPTER 1

INTRODUCTION AND PURPOSE AND NEED

CHAPTER 1 – INTRODUCTION AND PURPOSE AND NEED

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1.0. INTRODUCTION

1.1. Background Information

Thompson Creek Mining Company (TCMC) has submitted a modified[1] mining plan of operations (MMPO)[2] to the Bureau of Land Management (BLM) Challis Field Office; US Forest Service, Salmon-Challis National Forest (SCNF); and other cooperating agencies for an expansion and extension of mine life of the Thompson Creek molybdenum mine (TCM). In relation to the MMPO, TCMC has submitted an application to the US Army Corps of Engineers (USACE) for a permit under Section 404 of the Clean Water Act of 1972, as amended (CWA) to discharge dredged or fill materials into waters of the US (WUS). In addition, TCMC has submitted a separate proposal to exchange Federal land administered by the BLM for private lands owned[3] by TCMC. Such exchange would require amendment of the Challis resource management plan (RMP) (BLM 1999). Therefore, the proposed resource management plan amendment (PRMPA) is to identify the selected land in the land exchange proposal as suitable for disposal under the Federal Land Policy Management Act of 1976, as amended (FLPMA) (Section 1.7). The BLM and Forest Service have determined that their required responses to the MMPO and land exchange/PRMPA proposal would be significant Federal actions requiring preparation of an environmental impact statement (EIS).

There is a single current mining plan of operations (MPO) and MMPO for the mine – the reclamation plan is part of the MPO for the Federal agencies, whereas the Idaho Department of Lands (IDL) considers the "operating plan" to be part of the reclamation plan. The MPO comprises all approved modifications since its original submission in 1979. It includes a variety of plans in addition to the reclamation plan such as the interim management plan, water quality monitoring plan, water management plan, fugitive dust control plan, etc.

The MPO is administered by the BLM, Forest Service, and IDL, with each agency having jurisdiction for the portion of the mine that is on land administered by each agency. The BLM, Forest Service, and USACE must issue decisions in response to the MMPO, 404 permit application, and land exchange proposal (Section 1.6).[4] Consequently, these agencies are collaborating in the preparation of a single EIS that will be the basis for the agencies to issue their decisions. The US Environmental Protection Agency (EPA), Idaho Department of Environmental Quality (IDEQ), and IDL are also collaborating in the preparation of the EIS to ensure that the alternatives comply with Federal and State regulations within the respective jurisdictions of the agencies. Analysis of the effects of the alternatives (i.e., the Federal responses to the MMPO, 404 permit application, and land exchange proposal), including the preparation of an EIS, RMP amendment, and issuing records of decision (RODs) pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, is hereafter referred to as the

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[1] supplemental under 36 CFR 228.4(a)(3)

[2] Submitted in December 2008 with a revised version submitted in October 2009; "MMPO" herein refers to the revised version.

[3] The land and all related assets are listed in the name of Western States Land Management, Inc., who purchased and manages the land under written contract on behalf of TCMC. Therefore, TCMC is the effective owner/manager of the land.

[4] These decisions will not be issued until at least 30 days after the publication by the EPA of the notice of availability for this FEIS.

project. The project area is the geographic area that includes the surface disturbance of the mine (under all alternatives)[5] and the lands in the land exchange proposal (Figure 2.1-2., Figure 2.2-1., Figure 2.2-2. in Chapter 2), as well as the areas involved with the land disposal provisions (Section 2.2.7).

The mine is 7 air miles northwest of Clayton and 21 air miles southwest of Challis in Custer County, Idaho. The mine has been owned by a series of public and private companies since 1979. The mine is currently owned and operated by Cyprus Thompson Creek Mining Company, a wholly owned subsidiary of TCMC, which is a wholly owned subsidiary of Thompson Creek Metals Company Inc., a public company headquartered in Denver, Colorado.

Cyprus Minerals Corporation, through its exploration subsidiary Tuscarora Mining Company, staked the first mining claims on the Thompson Creek ore deposit in 1967. Exploration work began in earnest (e.g., diamond core drilling) in 1968 and continued throughout the 1970s. During this time VTN Colorado, Inc. (VTN 1975) completed the first of three substantial environmental documents for the mine – an EIS to provide baseline environmental information and evaluate mitigation measures for the anticipated effects of the mine.

Cyprus Minerals Corporation submitted a Notice of Intent to Operate and a MPO to the Forest Service and BLM in 1979 (Cyprus Mines Corporation 1979). In 1980 the Forest Service (lead agency) and the BLM (cooperating agency) completed a final EIS (FEIS) analyzing the effects of approving the MPO or alternatives (USFS 1980). The FEIS included analysis of no action, the proposed action (Alternative 1), and two additional alternatives (Alternative 2 and Alternative 3). Alternative 1 included an open-pit mine, waste rock storage facilities (WRSF), mill/concentrator facilities, tailings storage facility (TSF), and associated transportation and utility corridors. Alternative 1 was the agency environmentally-preferred alternative. Alternative 2 and Alternative 3 were similar to Alternative 1, but had different locations for some of the facilities. The key issues analyzed in the 1980 FEIS included those related to socioeconomic factors; water quality; fisheries, wildlife, cultural and paleontological resources; and the overall technical feasibility of the proposed mine. The Challis National Forest Supervisor and the BLM Challis Field Office Field Manager selected Alternative 1, which was consistent with the applicable Challis National Forest and BLM land use plans.

Construction of the mine began in January 1981, and commercial molybdenum production began in November 1983 and continues to date. The approved MPO describes only the final design limits on Federal lands of the mining operations that could be reasonably designed at that time. However, the open pit, WRSFs, and TSF were developed in phases because it was not economical to strip the waste rock overlying the entire ore body at once. Each phase consisted of stripping a slice of overlying waste rock (overburden), removing the exposed ore, milling the ore to extract a molybdenite concentrate, and placing the finely ground mill waste rock (tailings) in the TSF. The mine is currently in Phase 7, which corresponds to the final design limits of the approved MPO.

In 1999 the Forest Service (lead agency) and BLM (cooperating agency) completed a final supplemental EIS (FSEIS) evaluating a supplemental MPO submitted by TCMC. The supplemental plan describes modifications to the WRSFs and TSF to minimize the potential for acid rock

[5] The use of the term "alternatives" herein refers to the proposed actions and alternatives to the proposed actions.

drainage (ARD) from these facilities. The 1999 FSEIS included an analysis of no action (Alternative 1), the proposed action (Alternative 2), and two additional action alternatives (Alternative 3 and Alternative 4) (USFS 1999a). Alternative 2 included the following modifications to the WRSFs and TSF:

- Removing pyrite from the tailings during the non-freezing construction season (6 months per year) so pyrite-reduced tailings could be used in construction of the tailings embankment;
- Permanent subaqueous deposition of pyrite concentrates within the TSF;
- Characterizing waste rock to identify potentially acid-generating (Type 2) material and operating the Pat Hughes and Buckskin WRSF using selective segregation of Type 2 material; and
- Capping the final WRSF with a low-permeability cap and diversion of surface run-off around the WRSF.

Alternative 3 was the same as the proposed action except the pyrite would be removed from the tailings year-round instead of 6 months per year. In Alternative 4 the pyrite would be removed from the tailings year-round and disposed of at an off-site facility; waste rock management in Alternative 4 was the same as in the proposed action. The Forest Service and BLM selected Alternative 2 and gave interim approval of the MPO consistent with the alternative with RODs dated March 1999 (USFS 1999b) and January 2000 (USFS 2000). Additional Federal approval was not made due to the issuance of mineral patents in September 2000, i.e., the mine operations that were the subject of the SEIS came under IDL jurisdiction.

1.2. Proposed MMPO

As of September 2014, the cumulative surface disturbance of the mine was 2,191 acres on private land, 451 acres on land administered by the BLM Challis Field Office, and 181 acres on land administered by the SCNF (also referred to as National Forest System [NFS] land). The current operations consist of an open pit (5,200 feet long, 3,600 feet wide, 2,000 feet deep), two cross-valley-fill WRSFs in the Pat Hughes and Buckskin drainages (totaling 600 million tons), a TSF (745 feet high, 200 million tons) in the Bruno drainage, a mill, and a network of roads, pipelines, power lines, conveyor belts, sedimentation ponds, etc.

Under the current MPO (amended), which describes operations through Phase 7, the mine would cease production in late 2014. However, the proposed MMPO describes the Phase 8 expansion of the open pit, expansion of the WRSF and TSF (Figure 1.2-1.), and modifications to the existing long-term water management plan (the portion of the reclamation plan dealing with long-term water management). The MMPO would allow TCMC to produce molybdenum to approximately 2025 at the current rate of approximately 30,000 short tons per day of ore (15-20 million pounds/year of molybdenum), and TCMC would employ up to 400 full-time employees. Under Phase 8 all of the current proven and probable ore reserves at the mine would be processed. However, ore reserves are a dynamic concept subject to a variety of mining, metallurgical, economic, marketing, legal, environmental, social, and governmental factors.

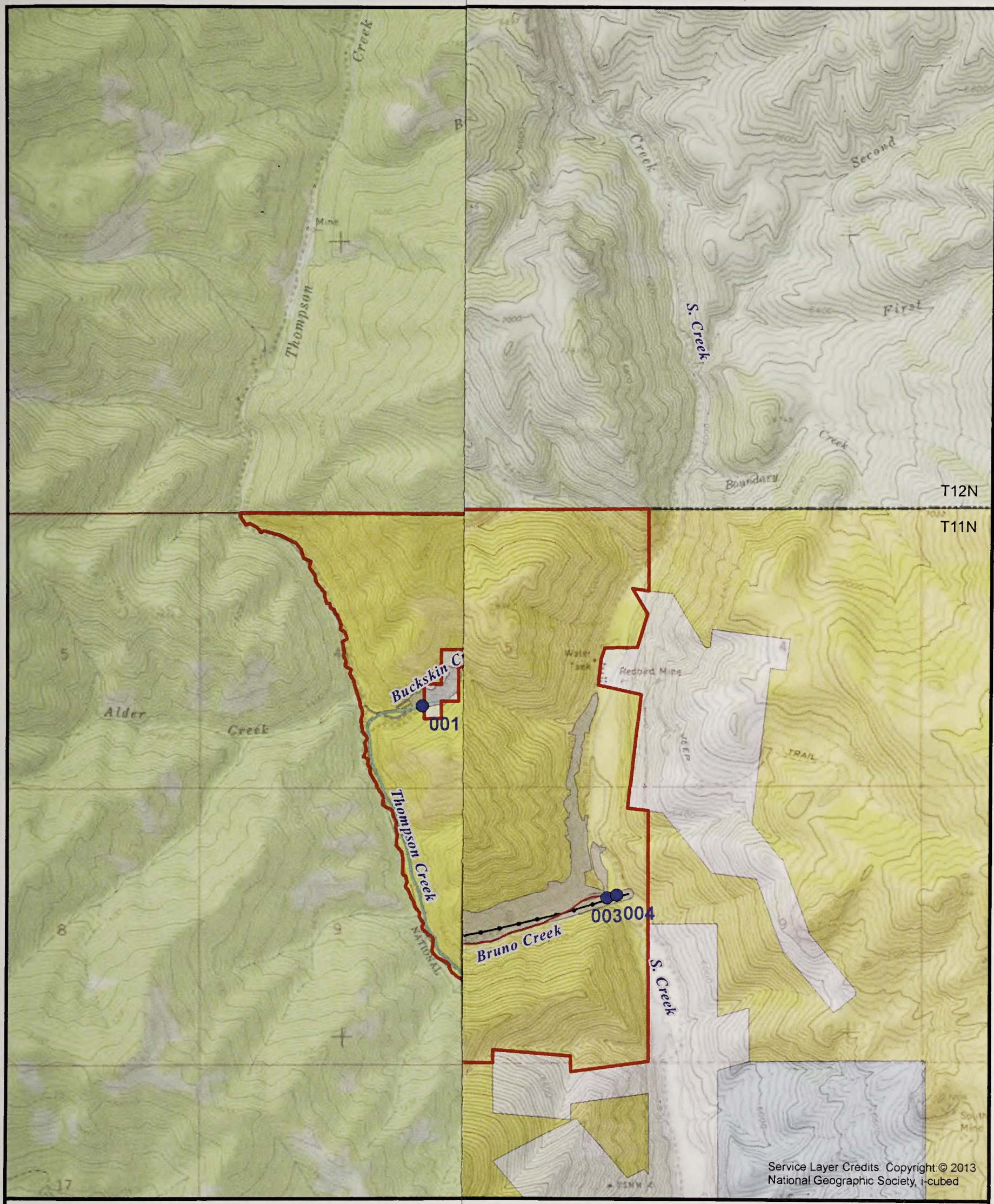
Therefore, the MMPO was developed based on a best estimate by TCMC of long-term market conditions, i.e., Phase 8 mining might not be completed, or an additional phase(s) could be proposed in the future. In either case, mine reclamation (that is not completed concurrent with mine production) would occur after mine production has ceased.

The additional surface disturbance at the mine from the MMPO would be 110 acres of private land owned by TCMC, 200 acres of BLM land, and 185 acres of NFS land. The mine currently includes approximately 2,800 acres of surface disturbance within a block of patented land and patented and unpatented mining claims comprising approximately 17,000 acres. Of this area, TCMC owns 2,686 acres fee simple (patented mining claims and 36 acres patented under the Small Tracts Act of 1983). The unpatented claims comprise approximately 6,000 acres of BLM land and 8,000 acres of NFS land.

Expansion of the open pit would be entirely on private property (patented mining claims) owned by TCMC. Overburden (waste material that must be mined to reach ore) from the open pit would be placed in the Buckskin and Pat Hughes WRSFs. Expansion of the WRSFs would cover 27 acres of private land, 171 acres of BLM land, and 54 acres of NFS land.

Expansion would also require additional tailings storage capacity, which would be accomplished by raising and partially realigning the current tailings embankment crest to a pre-reclamation elevation of 7,742 feet. Expansion of the TSF would cover 68 acres of private land, 11 acres of BLM land, and 52 acres of NFS land. In addition, a portion of a 24.9 kilovolt (kV) power line on NFS land would be relocated due to expansion of the open pit. The proposed utility corridor (4,900 feet in length, 200 feet in width, 21.9 acres) would be on a ridge between Bruno Creek and the head of Pat Hughes Creek, and would extend into the upper reaches of the Buckskin drainage. A water treatment plant was constructed in 2009 to blend and treat drainage water from the Pat Hughes WRSF, Buckskin springs, and the open pit. During mining the plant would continue to provide water for use in the mill as fresh water. After mining is completed, water from the TSF and WRSF drains would be collected and treated as necessary in a lime plant and piped to the open pit for storage. When the water level in the pit reaches the 7,030-foot elevation, water from the pit would be pumped to a treatment plant and treated water from the plant would be discharged to the Salmon River at a permitted EPA National Pollutant Discharge Elimination System (NPDES) outfall. More detailed information on the MMPO is provided in Chapter 2.

TCMC mines molybdenum on private and Federal land open to mineral entry pursuant to Federal mining laws. These laws confer a statutory right to conduct operations that are reasonably incident to exploration and development of locatable mineral deposits, in compliance with other applicable laws and regulations. TCMC submitted the MMPO describing the operations necessary to continue to develop the mine in a reasonable (economical, technologically feasible, and safe) manner. The operations are necessary for TCMC to continue to supply national and worldwide demand for molybdenum. TCMC has submitted a 404 permit application to obtain authorization to discharge dredged or fill materials into WUS. Such discharge would be necessary for TCMC to implement the MMPO.



iences.

Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land

Figure 1.2-1
Project area, MMPO area and selected land
Thompson Creek Mine EIS

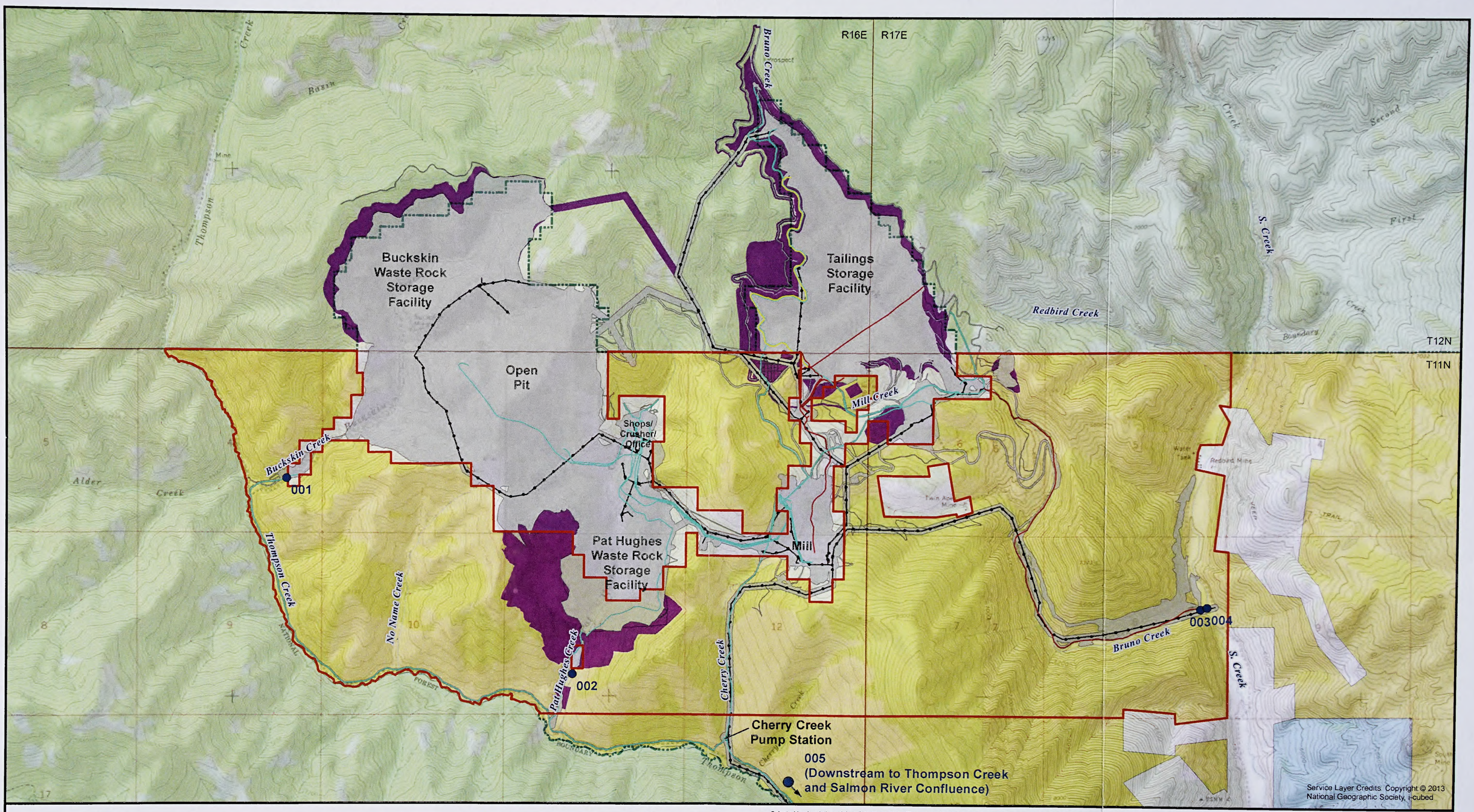
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Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 1.2-1
Project area, MMPO area and selected land
Thompson Creek Mine EIS

1.3. Proposed Land Exchange

The land exchange proposal involves approximately 5,100 acres[6] of BLM land (selected land) administered by the BLM Challis Field Office and approximately 900 acres of private land owned by TCMC (offered lands). The selected land contains the southern portion of the mine; the additional surface disturbance on Federal land described in the MMPO would occur on a portion of the selected land (Figure 1.2-1).

The offered lands consist of the Broken Wing Ranch, 6 miles northeast of Clayton in Custer County, and the Garden Creek property, 16 miles southeast of Pocatello in Bannock County, Idaho (Figure 1.3-1). The Garden Creek property would be managed under the Pocatello RMP; however, there is no site-specific management plan or criteria for the property. The Broken Wing Ranch would be managed largely according to the recommendations of the BLM Idaho Falls District Resource Advisory Committee (RAC), or by an alternative management plan as described in Chapter 2.

The Challis RMP identifies 63,075 acres of Federal land available in the BLM Challis Field Office area for disposal under the FLPMA. Such land does not include the selected land in the land exchange proposal. Therefore, if the BLM were to approve a land disposal alternative[7] involving disposal of any of the selected land, the BLM would first need to amend the RMP to identify such land as suitable for sale pursuant to Section 203 or exchange pursuant to Section 206 of the FLPMA.

TCMC is allowed to propose a land exchange involving Federal land pursuant to the FLPMA. Exchanges of Federal lands are permitted pursuant to Section 206 of the FLPMA if the public interest would be well served by the exchange. TCMC proposed the land exchange primarily to consolidate its land ownership in the vicinity of the mine and allow TCMC to safely, efficiently, and effectively manage the mine. The land exchange would also allow the BLM to obtain land with resource qualities considered to be of substantial value to the public in exchange for the Federal land that would be distinctly affected by mining. TCMC intends to expand its operations onto portions of the selected land pursuant to Federal mining laws and TCMC's ownership of unpatented mining claims. Therefore, the selected land would be affected by the proposed mining with little benefit to the general public, apart from economic effects, if the selected land remained under the jurisdiction of the BLM and the mine expanded. If the land exchange occurred, the BLM would administer the offered lands for the benefit of the public in exchange for the selected land that would be affected by mining.

This FEIS was prepared according to the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of the NEPA (40 CFR 1500-1508), the BLM NEPA

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[6] Unless otherwise noted, all areas herein are calculated from GIS data in contrast to *legally-described* areas, i.e., the areas listed on survey documents or deeds. For example, the legal area of the selected land is 5,143.97 acres and the calculated area is 5,068.00 acres. Also, the legal area of the Broken Wing Ranch (see below) is 775.64 acres and the calculated area is 812.46 acres. The selected land in the land exchange proposal is approximately 5,200 acres. However, as described in Chapter 2 and depicted on Figure 2.2-1., the selected land is evaluated in the FEIS with a modified east boundary and an area of approximately 5,100 acres.

[7] The BLM uses *land disposal* to refer to any action which involves land leaving Federal ownership, e.g., a land exchange or land sale. One of the alternatives to the land exchange evaluated in the FEIS is a land sale.

Handbook H-1790-1, and USFS National Environmental Policy Act Handbook (FSH 1909.15). The FEIS includes the following chapters:

Chapter 1 provides project background, describes the proposed Federal actions and the purposes and needs of such actions in response to the MMPO and land exchange proposal submitted by TCMC, and outlines public scoping that was part of the NEPA process.

Chapter 2 describes the alternatives related to the proposed MMPO and land exchange and potential mitigation actions to reduce or minimize effects, and identifies the agency-preferred alternative.

Chapter 3 describes the affected environment in the project area.

Chapter 4 describes the potential direct and indirect effects of the alternatives.

Chapter 5 describes the potential cumulative effects of the alternatives.

Chapter 6 summarizes the public involvement for the project; the decisions to be made and available administrative review options; the consultation and coordination with Federal and State agencies, as well as Native American Tribal consultation; and provides a list of the FEIS preparers and a summary of the interested parties.

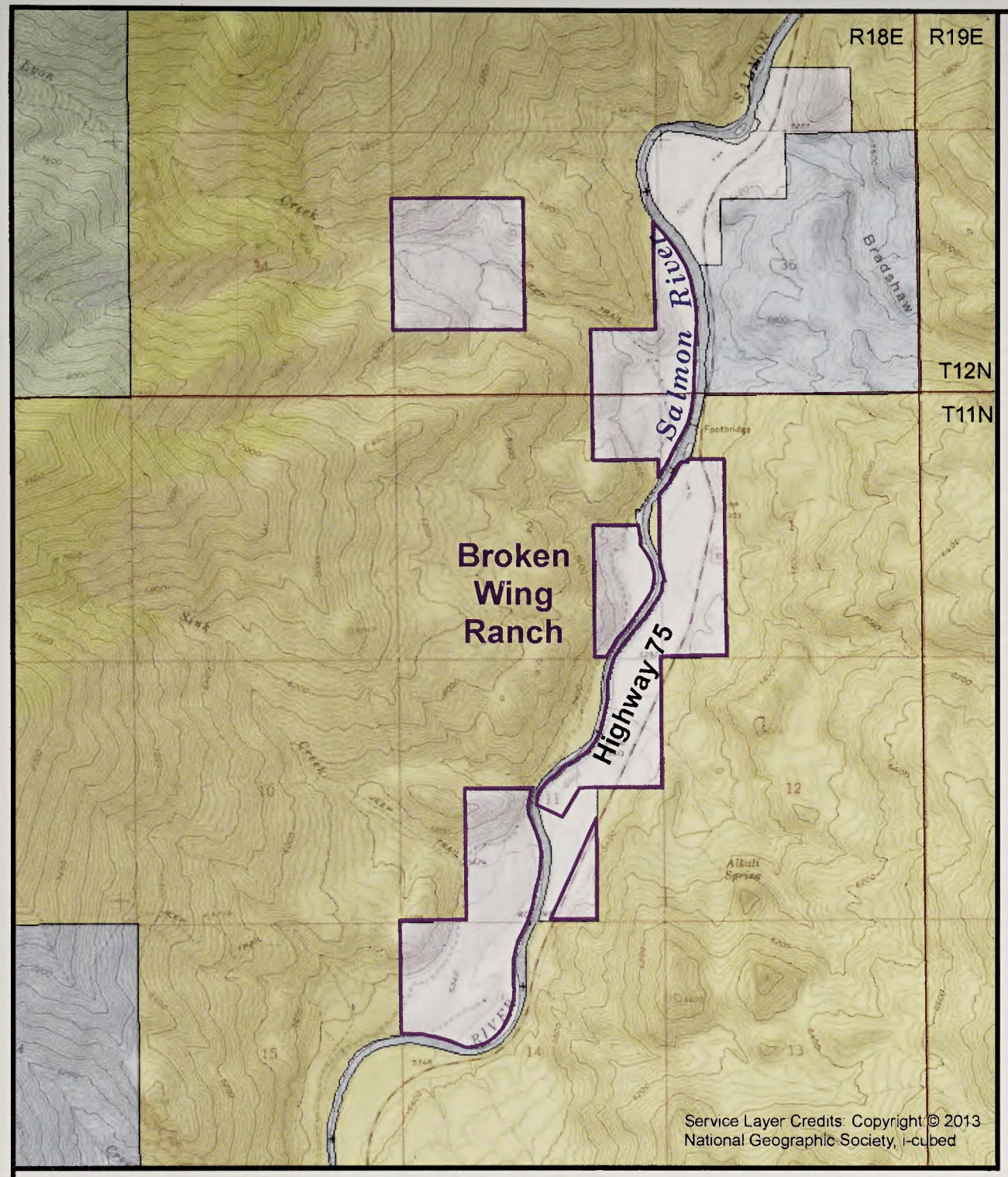
Chapter 7 summarizes the public comments on the draft EIS (DEIS) (released March 21, 2014 with a 90 day public comment period) and the agency responses.

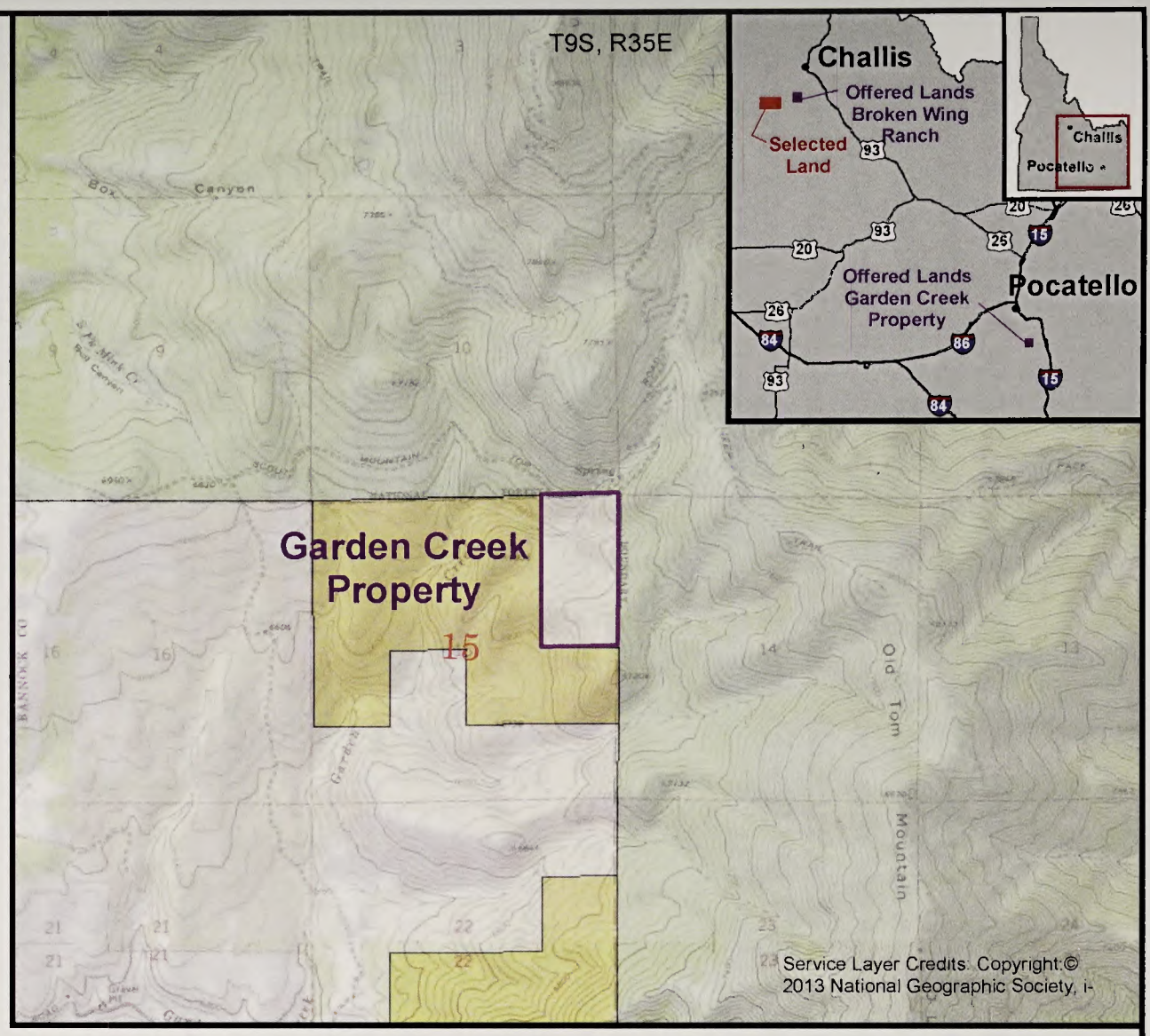
Chapter 8 lists references cited in developing the FEIS, as well as providing the index and glossary of terms.

1.4. Proposed (Federal) Actions

The BLM and Forest Service will respond to the MMPO in accordance with 43 Code of Federal Regulations [CFR] 3809.411(d) (BLM) and 36 CFR 228.5 (Forest Service) by denying the MMPO[8] as submitted, or approving the MMPO subject to changes, including additions, or conditions necessary to meet the requirements of the BLM surface management regulations (43 CFR 3809) and/or Forest Service mining regulations (36 CFR 228A). In response to the 404 permit application, the USACE will evaluate the alternatives and decide whether or not to issue a 404 permit. Any 404 permit issued may require special conditions or require TCMC to mitigate for project effects to offset unavoidable adverse effects to wetlands, streams and other aquatic resources authorized by the issuance of the permit. In response to the land exchange proposal, the BLM will decide whether to approve a Federal land disposal action, and whether to amend the Challis RMP to identify the selected land as suitable for disposal pursuant to the FLPMA.

[8] The BLM and Forest Service would approve only the respective portions of such plan for which each agency has jurisdiction. The portions of the plan involving private land would be approved by the IDL.





Legend

- Offered lands

Land Ownership

- BLM
- Private
- State
- Forest Service

Offered lands from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background is USGS 1:100,000-scale metric Topographic Maps.
Coordinate system UTM Zone 11 NAD 83

N

0 1:48,000 1
Miles
0 1
Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 1.3-1
Project area for land exchange, offered lands
Thompson Creek Mine EIS

Note that the BLM would issue a ROD for the MMPO even if the BLM approves a land disposal action alternative. This is because any land disposal title transfer would not occur until at least several months after a ROD approving such transfer. In addition, small areas of the mine (e.g., the Cherry Creek pump station) would remain on BLM land regardless of the outcome of the MMPO and land exchange. Instead of an MMPO, these areas might be authorized by special use permits and/or rights-of-way (ROWs) under the FLPMA, or these areas could remain authorized by the MMPO.

1.5. Purpose and Need

The purpose of the proposed Federal actions for the MMPO proposal is to respond to the proposal for a mine expansion and the extension of mine life. The BLM and Forest Service must determine if changes, including additions, or conditions to the MMPO are necessary prior to approval of the MMPO to meet the requirements of the BLM surface management regulations (43 CFR 3809) or Forest Service regulations (36 CFR 228A), within the context of TCMC's statutory rights under Federal mining laws. The purpose of the proposed 404 permit decision by the USACE is to ensure that any discharge that would be authorized by the permit would comply with the CWA and 33 CFR 320 *et seq*. The purpose of the proposed BLM action for the land exchange proposal is for the BLM to complete a land disposal if such would serve the national interest and meet the other requirements of the FLPMA, and, if so, for the BLM to amend the Challis RMP to identify the selected land as suitable for disposal in compliance with the FLPMA.

The need for the proposed Federal actions is related to the agencies' responsibilities under applicable Federal laws and regulations to consider and respond to the MMPO, 404 permit application, and land exchange proposal.

1.6. Responsible Officials, Decisions to be Made, Administrative Review

The responsible officials for the project are the Field Manager, Challis Field Office, BLM (MMPO); District Manager, Idaho Falls District, BLM (land disposal); State Director, Idaho State Office, BLM (RMP amendment); Forest Supervisor, SCNF, Forest Service (MMPO); and Chief, Regulatory Division, Walla Walla District, USACE (404 permit). Subsequent to the 30 day review period for the FEIS/PRMPA, the responsible officials from the BLM, Forest Service, and USACE will each prepare a ROD for the components of the project for which the officials have respective authority (Table 1.10-1.), and for which there are distinct objection processes (Sections 1.6.1. through 1.6.3). In making their decisions, the responsible officials will rely on a wide variety of information, including scoping input, the FEIS, recommendations from other agencies, applicable laws, and regulations and policies. The BLM and Forest Service will jointly release the FEIS and will distribute their RODs to all parties on the project mailing list, and on request to any interested party. The BLM and Forest Service will publish legal notices in local newspapers and provide news organizations with news releases announcing the availability of the RODs. The BLM will also announce the availability of the RODs via the BLM project website. The USACE ROD is an internal decision document provided to the proponent, but otherwise not normally distributed outside of the USACE.

Once the RODs are issued for the MMPO, TCMC will submit a MMPO that conforms to the selected alternative. The BLM, Forest Service, and IDL will administratively review and, when

appropriate, approve the "ROD" MMPO. The "ROD" MMPO will include the detail necessary for the agencies to administer the mine, e.g., engineering diagrams at appropriate site-level scales.

1.6.1. BLM

For the MMPO alternatives, in general the BLM will issue a decision regarding the storage of waste rock south of the open pit and long-term water management. The BLM will also issue a decision regarding the land disposal alternatives (exchange, sale, no action), and a decision regarding the PRMPA (that would be required if a land disposal action alternative is to be implemented). The BLM decision for the MMPO and land disposal alternatives will be subject to administrative review (appeal) pursuant to 43 CFR 3809.800. The BLM decision on the PRMPA will follow the 60 day Governor's Consistency Review period and will also be subject to administrative review (protest) pursuant to 43 CFR 1610.5-2. An adversely affected party that intends to file an appeal must do so in writing with the BLM office where the decision was made; in this case the Challis Field Office for the MMPO, the Idaho Falls District for the land disposal, and the Idaho State Office for the RMP amendment. This notice of appeal must contain the information specified in 43 CFR 3809.802 and must be made within 30 calendar days after the date the decision was received, unless State Director review is requested (43 CFR 3809.801).

1.6.2. Forest Service

For the MMPO alternatives, the Forest Service will issue a decision regarding the storage of waste rock north of the open pit, expansion of the TSF, and re-alignment of a section of power line. The Forest Service will issue a draft ROD subject to administrative review (objection) pursuant to 36 CFR 218 subparts A and B (pre-decisional administrative review). Objections will only be accepted from those who have previously submitted specific written comments regarding the MMPO during designated opportunities for public comment in accordance with §218.5(a). The first designated opportunity was the public scoping period (Section 1.12). The second opportunity was the 90 day public comment period for the DEIS. No further opportunities to obtain standing to object are anticipated for the project. Issues raised in objections must be based on previously submitted, timely, specific written comments regarding the proposal unless based on new information arising after the designated comment opportunities. A written objection must be submitted to the objection reviewing officer within 45 calendar days following the publication date of the legal notice of this opportunity to object in the Challis Messenger, Challis, Idaho. The objection must contain the minimum requirements specified in §218.8(d) and incorporation of documents by reference is permitted only as provided in §218.8(b). The publication date in the newspaper of record is the exclusive means for calculating the time to file an objection. If an objection is received on this project, a 45 day objection review period will begin.

Written objections must be submitted to: Nora Rasure, Objection Reviewing Officer, Federal Building, 324 25th Street, Ogden, Utah 84401 (postal) or (801) 625-5277 (facsimile). Electronic comments must be submitted in a format such as an email message, plain text (.txt), rich text format (.rtf), and Word (.doc or .docx) to appeals-intermtn-regional-office@fs.fed.us. Please type "Thompson Creek Mine FEIS" in the subject line for email messages and facsimile and include your mailing address and phone number.

At the end of the objection reviewing period the reviewing officer may consolidate objections and issue one response or may decide to issue a written response to each objection. The written response will be the final decision by the U.S. Department of Agriculture on the objections. Once the reviewing officer has issued the response to the objections and the responsible official has followed any instructions contained in the written response, or if no objections are received, the responsible official may sign the final revised ROD and implement the project without further legal notice of the decision. Interested and affected parties will be informed of the decision. The signing of the revised ROD in accordance with 40 CFR 1506.10 may occur on, but not before, the 5th business day following the end of the objection filing period.

1.6.3. USACE

For the MMPO alternatives, the USACE will issue a decision regarding a 404 permit for WUS that would be filled under an MMPO alternative. Under the USACE appeal process dated March 28, 2000, "a District Engineer's decision on an approved jurisdictional determination, a permit denial or a declined individual permit is subject to an administrative appeal by the affected party in accordance with the procedures and authorities contained in 33 CFR Part 331." Affected party means "a permit applicant, landowner, or a lease, easement, or option holder (i.e., an individual who has identifiable and substantial legal interest in the property) who has received an approved jurisdictional determination, permit denial, or has declined a proffered individual permit." Therefore, in the case of the USACE the decision could only be administratively appealed by the TCMC.

1.7. Relationship to Agency Policies, Plans, and Programs

The proposed Federal actions have been reviewed for compliance with agency policies, plans, and programs. Three Federal land use plans guide the use of Federal land in the project area: the BLM Pocatello RMP (BLM 2012a), BLM Challis RMP (BLM 1999) and the Challis National Forest land and resource management plan (LRMP) (USFS 1987), as amended (USFS 1991-2004). Additionally, the BLM Land Use Planning Handbook (BLM 2005a), Land Exchange Handbook (BLM 2005b), and Public Sales Manual (BLM 1985) were reviewed to confirm compliance with this guidance.

BLM Pocatello RMP (BLM 2012a)

The alternatives involving the Garden Creek property would conform with the Pocatello RMP, specifically the priority in Zone 3 to "consolidate ownership, which will maximize public values, provide public access and improve efficiencies in public lands[9] administration. Overall public land acreage will be maintained. Acquisition, primarily through exchange, will be done to add high resource value lands that improve the manageability of public lands; lower resource value and difficult-to-manage tracts will be disposed of" (BLM 2012a, p. 80). The Garden Creek property is also within an access acquisition priority area (BLM 2012a, p. 75; Figure 8 in the RMP). The Pocatello RMP also specifies "Lands acquired will be managed in a manner consistent with adjacent or nearby public lands or managed for the goals, objectives and standards for which they were acquired" (Goal 5/Objective 5.1/LR-5.1.1.) and "Management

[9] BLM-administered land is commonly referred to as public land, whereas the Forest Service-administered land is commonly referred to as National Forest System land. Therefore, *Federal land* is used in the FEIS to refer to both types of public lands.

direction, including designations for such programs as OHV, SRMA, VRM,[10] and Livestock Grazing, will be applied to acquired lands consistent with adjacent or nearby public lands, or those with similar values, goals and objectives for which they were obtained" (Goal 5/Objective 5.1/LR-5.1.2.) (BLM 2012a, p. 76).

BLM Challis RMP (BLM 1999)

The MMPO alternatives would conform to the Challis RMP, i.e., "It is Federal policy to allow development of Federal mineral resources and promote reclamation of disturbed lands. Mineral exploration and development are a statutory right on unappropriated and unreserved public lands, except where specifically withdrawn from mineral entry under Secretarial or Congressional authority" (BLM 1999, p. 43).

The land disposal alternatives would conform to various specific objectives of the Challis RMP, e.g., "Seek to acquire additional lands having high public values, through land actions such as exchange…" (BLM 1999, p. 31) and "Attempt to acquire legal access through purchase, exchange, or donation as follows: …(c) legal, public access in…Lyon Creek" (BLM 1999, p. 36). The land disposal alternatives would conform overall with the Challis RMP if the following section of the RMP were amended to include the selected land (which is one of the proposed Federal actions for the project): The "FLPMA allows for sale or other disposal of public lands when specific criteria are met, including identification of those lands during the land use planning process…Only the BLM tracts within the adjustment areas shown on *Map A: Adjustment/Management Areas* (~ 63,075 acres) would be made available for disposal under the Federal Land Management and Policy Act" (BLM 1999, p. 33).

If necessary, all other items in the Challis RMP that might otherwise preclude any of the land disposal alternatives would also be amended to clarify that such items would not apply to the selected land, e.g., "Maintain a 'no net loss' of salmon, steelhead trout, and bull trout habitat by limiting land exchanges of salmon, steelhead trout, and bull trout habitat to like habitat of equal or greater values" (BLM 1999, p. 24); "Retain public lands under BLM administration unless the receiving parties agree to continue to maintain or to restore (if degraded) and permanently maintain floodplains and wetland functions" (BLM 1999, p. 33); and "Riparian areas, floodplains, and wetlands transferred out of public ownership would contain covenant language in the deed to protect the wetland resource values from degradation" (BLM 1999, p. 34).

If acquired lands (i.e., the offered lands) are surrounded by or adjacent to BLM land, the BLM may extend applicable land use plan decisions to these lands via plan maintenance instead of a plan amendment (BLM 2005a, p. 16), e.g., if the BLM acquires the Broken Wing Ranch, the BLM may authorize grazing on the ranch without amending the Challis RMP.

[10] OHV = off-highway vehicle, SRMA = special recreation management area, VRM = visual resource management

Challis National Forest LRMP (USFS 1987)

The project would involve two Management Areas (MAs) in the LRMP: MA 8 (Thompson Creek) and MA 9 (Squaw[11] Creek). Management prescriptions have been developed and are applied to specific areas of NFS lands to attain multiple-use and other goals and objectives. Management prescriptions for MA 8 emphasize enhancement of wildlife habitat, and provide for minerals activities and dispersed recreation opportunities. Management prescriptions for MA 9 emphasize enhancement of fish and wildlife habitat, range administration, maintenance of water quality, timber production, and dispersed recreation. The prescriptions for MA 9 also recognize the high locatable mineral occurrence and probable future mineral development. The LRMP identifies the mine as a current use within each of these MAs (USFS 1987); therefore, the MMPO alternatives would be in conformance with the LRMP.

The LRMP was amended by the "Interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington, Idaho, and portions of California" commonly known as PACFISH (PACFISH 1995). The Forest Service interprets the PACFISH standards and guidelines for road management to apply to mining operations in addition to the standards and guidelines for minerals management. Therefore, separate from the NEPA process, a "PACFISH" watershed analysis will be prepared prior to the Forest Service issuing a ROD for the MMPO alternatives.

BLM Land Use Planning Handbook (BLM 2005a)

The land disposal alternatives are subject to the planning requirements and guidance outlined in the BLM Land Use Planning Handbook. Specifically, the handbook describes the procedures to amend the Challis RMP to identify the selected land as suitable for disposal (i.e., sale or exchange) pursuant to the FLPMA.

BLM Land Exchange Handbook (BLM 2005b)

The land exchange alternatives are subject to the planning requirements and guidance outlined in the BLM Land Exchange Handbook. The land exchange proposal is a single phase-assembled transaction involving multiple parcels of Federal and/or non-Federal land that are exchanged under one closing and values equalized under 43 CFR 2201.6. The BLM completes land exchanges on an equal monetary value basis with differences in monetary value between the Federal and non-Federal lands equalized by the addition or subtraction of lands and/or a cash payment. Cash payments may not exceed 25 percent of the value of the Federal lands involved in the land exchange, and the goal is to minimize the amount of any cash payment. In most cases the BLM shares the costs equally with the proponent in processing a land exchange proposal. However, to date, TCMC has paid more than 95 percent of such costs.

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[11] *Squaw Creek* is an official place name in Custer County, and appears in numerous published documents including US Geological Survey topographic maps. The name was established by the US Board of Geographic Names to maintain uniform geographic name usage throughout the Federal Government. However, the word *Squaw* is offensive to some people including the Shoshone-Bannock Tribes. Therefore, *Squaw Creek* is hereafter referred to in the main text as *S. Creek*.

BLM Public Sales Manual (BLM 1985)

The land sale alternative is subject to the planning requirements and guidance found in the BLM Public Sales Manual. In particular, tracts of BLM land may be offered for sale only at appraised fair market value and if they have been identified for disposal through land use planning, having been found to meet the disposal criteria of Section 203(a)(1, 2 or 3) of the FLPMA, e.g., 203(a)(1) "such tract because of its location or other characteristics is difficult and uneconomic to manage as part of the public lands, and is not suitable for management by another Federal department or agency" or 203(a)(3) "disposal of such tract will serve important public objectives, including but not limited to, expansion of communities and economic development, which cannot be achieved prudently or feasibly on land other than public land and which outweigh other public objectives and values, including, but not limited to, recreation and scenic values, which would be served by maintaining such tract in Federal ownership."

Land sales may be competitive, modified competitive, or direct (non-competitive), with direct sales used for "protection of an authorized use, such as an existing business, which would be threatened if the tract were purchased by other than the authorized user" (BLM 1985, 0.06.E.3.c). The handbook guidance is from Federal regulations which specify that direct sales may be used, e.g., when a tract identified for sale is an integral part of a project or public importance and speculative bidding would jeopardize a timely completion and economic viability of the project; there is a need to recognize an authorized use such as an existing business which could suffer a substantial economic loss if the tract were purchased by other than the authorized user; or the adjoining ownership pattern and access indicate a direct sale is appropriate (43 CFR 2711.3-3).

1.8. Relationship to Non-Agency Policies, Plans, and Programs

Two local plans guide land use in Custer County: the Custer County comprehensive plan (Custer County 2006) and the Custer County multi-jurisdiction all hazard mitigation plan (Custer County 2009). These plans provide guidance on identifying and reducing hazards, including human-made hazards, to the residents of Custer County, as well as stating the goals and objectives for land use planning. The project would not add new hazards that could affect residents, and would conform to the land use planning guidance of these plans.

1.9. Principle Authorities

The following is a general description of the principle authorities under which this FEIS has been prepared, and is not intended as a comprehensive statement of the rights and obligations of the Federal government, State government, or TCMC under any such authority or permit issued pursuant thereto.

1.9.1. The National Environmental Policy Act of 1969, as amended (42 USC 4321 *et seq.*)

The NEPA is the basic national charter for protection of the environment and governs the preparation of an EIS. The NEPA requires Federal agencies to consider the potential environmental effects and alternatives to a proposed Federal action in an environmental document with appropriate analyses. The NEPA ensures that environmental information is available to public officials and citizens before actions are taken. The EPA and CEQ regulations for implementing the NEPA are 40 CFR 6 and 40 CFR 1500-1508, respectively.

1.9.2. The Federal Land Policy and Management Act, as amended (43 USC 1701 *et seq.*)

The FLPMA is the authority for BLM land exchanges (43 CFR 2200), land sales (43 CFR 2710), land use plans (43 CFR 1600), and surface management regulations regarding mining for locatable minerals, e.g., molybdenum (43 CFR 3809). Under cost recovery regulations pursuant to the FLPMA, TCMC is paying the costs of completing the NEPA analysis for the proposed MMPO (70 FR 58854), and is voluntarily paying the costs to complete the NEPA analysis for the land exchange proposal. The BLM may also authorize agriculture and grazing under the FLPMA. In addition, the BLM may authorize grazing under Section 302 of the Taylor Grazing Act of 1934, as amended (43 USC 1732), or via a stewardship agreement under Section 323 of the Omnibus Appropriations Bill of 2003 (16 USC 2014 notes).

1.9.3. The Organic Administration Act of 1897, as amended (16 USC 471 *et seq.*); Multiple-Use Sustained-Yield Act of 1960, as amended (16 USC 528-531); Forest and Rangeland Renewable Resources Planning Act of 1974, as amended (16 USC 1601-1610); and National Forest Management Act of 1976, as amended (16 USC 1600 *et seq.*)

These laws govern the administration of NFS lands including forest plans (36 CFR 219) and locatable mining activities (36 CFR 228A).

1.9.4. Federal Mining Laws (e.g., 30 USC 21 *et seq.*, 30 USC 601 *et seq.*)

These laws govern the right to mine locatable minerals, including molybdenum, on Federal lands.

1.9.5. The Endangered Species Act of 1973, as amended (16 USC 1531-1544)

The Endangered Species Act (ESA) provides for the conservation of threatened and endangered species and their habitats. Federal agencies are required by the ESA (Section 7) to consult with the US Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) to ensure that any action authorized, funded, or carried out by a Federal agency will not likely jeopardize the continued existence of threatened and endangered species or result in the destruction or adverse modification of critical habitat.

1.9.6. The Migratory Bird Treaty Act of 1918, as amended (16 USC 703-712)

The Migratory Bird Treaty Act (MBTA) is part of the establishment of an international framework for the protection and conservation of migratory birds. The MBTA prohibits, except as permitted by regulation, the take of certain migratory birds. *Take* means to pursue, hunt, shoot, wound, kill, trap, capture or collect, or any attempt to carry out these activities (50 CFR 10). A take does not include habitat destruction or alteration, as long as there is not a direct taking of birds, nests, eggs, or parts thereof. A take must be reasonably anticipated, e.g., the death of a protected bird by collision with power lines, vehicles or building windows are not generally probably occurrences and would not normally result in a violation of the MBTA.[12] There are no provisions for incidental take under the MBTA. Executive Order 13186 directs Federal Executive departments and agencies to take certain actions to further implement the

[12] Seattle Audubon Society v. Evans, 952 F.2d 297 (9th. Cir.1991); Mahler v. US Forest Service, 927 F.Supp.1502 (D.Or.1991); US v. Moon Lake Electric Association, 98-CR-228-B (D. Colo., 20 January 1999)

MBTA, such as requiring agencies to take reasonable steps that include restoring and enhancing habitat, incorporating migratory bird conservation into planning processes, promoting research and information exchange, providing training and visitor education, and developing partnerships beyond agency boundaries.

Per Executive Order 13186, USFWS and BLM entered into a Memorandum of Understanding (MOU) in 2010 to promote the conservation of migratory bird populations (BLM and USFWS 2010). The MOU directs BLM to evaluate the effects of its actions on migratory birds through the NEPA process, and identify where take may have a measurable, negative effect on migratory bird populations, focusing on species of concern, priority habitats, and key risk factors. Where take is expected, BLM shall coordinate with USFWS and develop conservation measures to minimize, reduce, or avoid incidental take, and monitor the effectiveness of these conservation measures.

1.9.7. The Bald and Golden Eagle Protection Act of 1940, as amended (16 USC 668-668d)

The Bald and Golden Eagle Protection Act (BGEPA) provides for the protection of the bald eagle and the golden eagle by prohibiting, except under certain specified conditions, the taking (see Section 1.9.6.), possession, and commerce of such birds, alive or dead. Activities that would disturb bald or golden eagles are prohibited under the Act. "Disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

1.9.8. The Clean Water Act of 1972, as amended (33 USC 1251 *et seq.*)

The primary objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's surface waters by eliminating the discharge of pollutants into these waters, and achieving water quality levels that are safe for fish, shellfish, wildlife, and recreation in and on water. Section 402 of the CWA provides for the NPDES, which is administered in Idaho by the EPA.

No amendment or modification of TCMC's NPDES permit would be required to implement the MMPO. Section 319 of the CWA requires that each state develop a management program, including the development of best management practices (BMPs), to reduce nonpoint sources of pollution to waters[13] within the state. Section 404 of the CWA provides the authority for the USACE to issue permits for the discharge of dredged or fill materials into WUS, including adjacent wetlands (33 CFR 320-330). The EPA provides guidelines for the disposal of dredged or fill material into WUS (Section 404[b][1]). These guidelines form the substantive environmental criteria used by the USACE to review proposed discharges and issue permits under Section 404 of the CWA; the guidelines prohibit issuance of a permit that would cause an avoidable or significant adverse effect to WUS. Compliance with the guidelines is required before a permit can be issued by the USACE, and demonstrating compliance is the responsibility of the applicant. Section 230.10 contains the four principle requirements for compliance: failure to *"clearly demonstrate"* that there is no *"practicable alternative to the proposed discharge*

[13] The law states "navigable waters" but such are "waters of the United States" (33 USC 1362).

which would have less adverse impact on the aquatic ecosystem," in accordance with Section 230.10(a), renders the project noncompliant with the guidelines.[14]

The IDEQ is responsible under Section 401 of the CWA (33 USC 1341) for certifying that activities that may result in discharges into waters within Idaho will comply with the applicable provisions of the CWA (33 USC 1311-1313, 1316 and 1317) and State water quality standards (IDAPA 58.01.02).

1.9.9. The Clean Air Act of 1970, as amended (42 USC 7401 *et seq.*)

The key purpose of the Clean Air Act (CAA), is "…to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." In addition, Section 309 of the CAA requires the EPA to review and publicly comment on the environmental effects of major Federal actions which are the subject of EISs. The IDEQ administers portions of the CAA under IDAPA 58.01.01. No amendment or modification of TCMC's CAA permit would be required for TCMC to implement the MMPO.

1.9.10. Secretarial Order No. 3226 Amendment No. 1

Secretarial Order No. 3226 Amendment No. 1 states that each bureau and office of the US Department of the Interior (DOI) shall "consider and analyze potential climate change impacts when undertaking long-range planning exercises, or when making major decisions affecting DOI resources." The CEQ issued "Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions [GHG]" on February 18, 2010. The guidance states that "climate change issues arise in relation to the consideration of: (1) The GHG emissions effects of a proposed action and alternative actions; and (2) The relationship of climate change effects to a proposed action or alternatives, including the relationship to proposal design, environmental impacts, mitigation and adaptation measures" (CEQ 2010).

1.9.11. The Federal Noxious Weed Act of 1974, as amended (7 USC 2801-2814)

The Federal Noxious Weed Act provides for the control and management of non-indigenous (non-native) weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health. The law requires that each Federal agency develop a management program to control undesirable plants on Federal lands under the agency's jurisdiction; establish and adequately fund the program; implement cooperative agreements with state agencies to coordinate management of undesirable plants on Federal lands; and establish integrated management systems to control undesirable plants targeted under cooperative agreements. The current BLM Challis Field Office integrated weed control program was approved in 2009 (BLM 2009a). The current BLM Pocatello Field Office weed control program was approved in 2012 (BLM 2012a). Both programs are consistent with the approved alternative of the BLM programmatic EIS for vegetation treatments using herbicides (BLM 2007). The SCNF manages weeds consistent with the Challis National Forest LRMP (USFS 1987) and a biological assessment and biological opinions specific to noxious weed management (USFWS 2004; NMFS 2007). TCMC would be required to comply with all aspects of these programs and plans in any approved MMPO. Additionally, if the offered lands were

[14] A CWA Section 404(b)(1) alternatives analysis demonstrating compliance with these principles (HDR 2014a) is provided as Appendix A.

acquired by the US, the offered lands would be managed under the BLM Challis Field Office weed control program (Broken Wing Ranch) and the BLM Pocatello Field Office weed control program (Garden Creek property).

1.9.12. The Archaeological Resource Protection Act of 1979 (16 USC 470aa-mm); National Historic Preservation Act of 1966, as amended (16 USC 470 *et seq.*)

The purpose of the Archaeological Resource Protection Act (ARPA) is to secure the protection of archaeological resources and sites on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals having collections of archaeological resources. The ARPA prohibits the collection of archaeological resources from public lands (and Indian lands) without a permit issued by the land managing agency, and establishes criminal and civil penalties for removal, sale, purchase, exchange, transportation, receipt, or offering of any archaeological resource obtained from public lands (or Indian lands) in violation of any provision, rule, regulation, ordinance, or permit under the act, or under any federal, state, or local law. The law applies to any agency that receives information that a direct or Federally-assisted activity could cause irreparable harm to prehistoric, historic, or archaeological data and provides criminal penalties for prohibited activities. The BLM follows the ARPA implementing regulations (43 CFR 7).

The National Historic Preservation Act (NHPA) requires Federal agencies to consult with State and local groups on Federal undertakings before nonrenewable historic properties, such as archaeological sites and cultural resources, are damaged or destroyed. Historic properties are those properties (i.e. cultural resources, archaeological resources, etc.) that are included in or that meet the criteria for inclusion in the National Register of Historic Places (NRHP). Section 106 of the NHPA requires Federal agencies to review the effects that proposed Federal actions may have on the historic properties (i.e. NRHP-eligible cultural or archaeological resources) in the project area (36 CFR 800). If it is determined that the proposed action may affect historic properties, consultation would be required between the Federal agencies and the State Historic Preservation Office (SHPO) and/or Tribal Historic Preservation Officers, Tribes, consulting parties, and the public. If it is determined that no historic properties would be affected, the agencies have no further Section 106 obligations.

1.9.13. Paleontological Resources Preservation Act of 2009 (123 Stat. 1172; 16 USC 470aaa)

The major law protecting paleontological resources (fossils) on public lands is the Paleontological Resources Preservation Act of 2009, which established authorities for permitting, collecting, and protection of the resource and provisions for criminal and civil penalties for violations of the law. Other laws and regulations protecting paleontological resources on public lands include the FLPMA and BLM regulations such as 43 CFR 8365.1-5.

1.9.14. Federal Agency Responsibilities to Federally-Recognized Tribes

Native American tribes are afforded specific rights under various Federal laws including the NHPA; the National Forest Management Act (NFMA); the ARPA; the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990, as amended (25 USC 3001 *et seq.*); the Religious Freedom Restoration Act of 1993, as amended (42 USC 2000bb); the American Indian

Religious Freedom Act (AIRFA) of 1978, as amended (42 USC 1996, 1996a); Secretarial Order No. 3317, "Policy on Consultation with Indian Tribes;" and Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments." Federal guidelines (see below) direct Federal agencies to consult with Federally-recognized Native American tribal representatives who may have concerns about Federal actions that may affect religious practices, other traditional cultural uses, as well as cultural resource sites and remains associated with Native American ancestors. Any Federally-recognized tribe whose aboriginal territory occurs within the project area is afforded the opportunity to voice concerns for issues governed by the NHPA, NAGPRA, or AIRFA.

The Federal responsibility to consult with Native American tribes on such matters as the project is required by the NFMA, Interior Secretarial Order 3175 of 1993, and Executive Orders including 12875 and 13007. Executive Order 12875 calls for regular consultation with tribal governments. Executive Order 13007 requires consultation with Native American tribes and religious representatives on the access, use, and protection of Native American sacred sites. The NEPA regulations require that the lead agency for preparing an EIS shall invite the participation of any affected Indian tribe as part of the scoping process (40 CFR 1501.7).

1.9.15. The Idaho Constitution

Under the Idaho Constitution the right to mine on private land in Idaho is a basic property right. The Idaho Constitution also provides the right to divert and appropriate water, with preference for mining purposes.

1.9.16. The Environmental Protection and Health Act of 1972, as amended (39 Idaho Statutes 101 *et seq.*)

The Environmental Protection and Health Act is the State law under which the IDEQ regulates air and water quality. The purpose of the law is "to provide for the protection of the environment and the promotion of personal health and to thereby protect and promote the health, safety, and general welfare of the people of this state." The IDEQ regulates water quality under IDAPA 58.01.02 (surface water) and 58.01.11 (groundwater), and air quality under IDAPA 58.01.01.

1.9.17. The Idaho Surface Mining Act of 1971, as amended (47 Idaho Statutes 1501 *et seq.*)

The Idaho Surface Mining Act states in part that its purpose is to provide for the protection of the public health, safety and welfare, through measures to reclaim the surface of all the lands within the state disturbed by exploration and surface mining operations and measures to assure the proper closure of cyanidation facilities and thereby conserve natural resources; aid in the protection of wildlife, domestic animals, and aquatic resources; and reduce soil erosion. The IDL regulates surface mining and reclamation in Idaho under IDAPA 20.03.02 and has the authority to hold financial guarantees for mine reclamation under IDAPA 20.03.02.120-123. However, the IDL may not have the authority to hold financial guarantees for water treatment or to hold trust funds or other funding mechanisms for long-term, post-mining reclamation liabilities such as monitoring and maintenance. The IDL authority for the reclamation of mine tailings impoundments overlaps with the Idaho Department of Water Resources (IDWR) authority to ensure such structures are placed in a safe, maintenance-free condition at the end of mining operations (Section 1.9.19).

1.9.18. Idaho Water Quality Standards (IDAPA 58.01.02)

The IDEQ is responsible for administering the Idaho water quality standards, which define the designated beneficial uses of a surface water segment and the water quality criteria necessary to support those uses. These standards consist of 1) an anti-degradation policy to maintain and protect existing uses and high quality waters (IDAPA 58.01.02.051), 2) beneficial (designated) uses of the water body, e.g., recreation, water supply, aquatic life, agriculture (IDAPA 58.01.02.100), and 3) water quality criteria (numeric pollutant concentrations and narrative requirements) to protect designated uses (IDAPA 58.01.02.200 *et seq*). Idaho also has the right to create general policies that address implementation issues such as low flows, variances, and mixing zones.

1.9.19. Idaho Groundwater Quality Rule (IDAPA 58.01.11)

The IDEQ is responsible for administering the Idaho Ground Water Quality Rule. More specifically, groundwater must be managed in a manner which maintains or improves existing groundwater quality through the use of BMPs and best practical methods to the maximum extent practical (IDAPA 58.01.11.301). The IDEQ has established numeric and narrative groundwater quality standards that apply to all groundwater in Idaho (IDAPA 58.01.11.200). In addition, the quality of groundwater that discharges to surface water shall not impair the identified beneficial uses of the surface water, and surface water infiltration shall not impair the beneficial uses of groundwater (IDAPA 58.01.11.150.03). However, the groundwater quality rule specifically is designed to protect groundwater and allow for the extraction of minerals above and within groundwater (IDAPA 58.01.11.006.06). Such is achieved by authorizing a groundwater mineral extraction zone: "Naturally occurring constituents found in groundwater within a specified area surrounding an active mineral extraction area, as determined by the Department, will not be considered contaminants as long as all applicable best management practices, best available methods or best practical methods, as approved by the Department, are applied" (IDAPA 58.01.11.400.06).

1.9.20. Idaho Mine Tailings Impoundment Structures Rule (IDAPA 37.03.05)

The IDWR regulates the construction, maintenance, and operation of mine tailings impoundments in Idaho, and has the authority to hold financial guarantees to ensure the impoundments are placed in safe, maintenance-free condition if abandoned by the owner without conforming to the approved abandonment plan (IDAPA 37.03.05.040).

1.9.21. Idaho Safety of Dams Rule (IDAPA 37.03.06)

The IDWR regulates the construction and maintenance of certain size dams which impound water in Idaho. Such dams at the TCM are the downgradient face of the Pat Hughes sedimentation pond and the seepage return dam (SRD) below the TSF.

1.9.22. Financial Guarantees

TCMC is required to fully reclaim the mine according to the approved reclamation plan pursuant to 43 CFR 3809 (BLM), 36 CFR 228 (Forest Service), IDAPA 20.03.02 (IDL), and IDAPA 37.03.05 (IDWR). Accordingly, TCMC periodically submits to the agencies estimates of the costs to complete such reclamation using a third-party contractor in the event the operator cannot or will not perform such reclamation. Once the amounts are approved by the agencies,

TCMC submits irrevocable financial guarantees to the agencies in these amounts pursuant to 43 CFR 3809.500 (BLM), 36 CFR 228.13 (Forest Service), IDAPA 20.03.02.120 (IDL), and IDAPA 37.03.05.040 (IDWR). For example, the financial guarantees include agency administrative costs, are calculated for the period when the operations would be most expensive to reclaim in the near future, and are calculated assuming none of the mine equipment or facilities would be available for use in the reclamation. The agencies must approve the reclamation cost estimates and the financial guarantee instruments prior to the initiation of the mine operations or modified operations covered by the estimates. That is, TCMC provides reclamation cost estimates and financial guarantees for stages of the MPO commensurate with their implementation; TCMC is not required to provide reclamation cost estimates and financial guarantees for portions of the operations that would not be built for many years.

The reclamation cost estimate will continue to be periodically adjusted to account for changes in the reclamation cost, e.g., increased as the future reclamation costs increase due to inflation or greater surface disturbance, or decreased as the future reclamation costs decrease due to deflation or completed reclamation. The purpose of the financial guarantees is to assure reclamation of surface disturbance to prevent or control damage to the environment, e.g., to control erosion, landslides, water run-off, and toxic materials; to mitigate disturbance to visual resources; and to provide for rehabilitation of fish and wildlife habitat. Reclamation includes water treatment if appropriate.[15] The specific amounts of financial guarantees are part of the BLM administrative (regulatory) process and are not NEPA issues. Accordingly, the agencies may require revised reclamation cost estimates/financial guarantees at any time deemed appropriate by the agencies.

The current reclamation plan does not explicitly include active water treatment as part of the long-term water management, which was not evaluated in detail in either of the two previous EISs for the mine. Accordingly, there has been no basis on which to estimate the costs of long-term water management. However, it is now possible using the best available science to describe the present and future water quality of the mine site with reasonable accuracy, e.g., the data from more than 30 years of detailed water quality monitoring at the mine site are available, the chemistry of pit lakes can now be reasonably determined, etc. Consequently, the present and future water quality of the mine site has been extensively evaluated as part of the NEPA process, and all of the MMPO alternatives include active water treatment as part of long-term water management for the mine.

The BLM will hold the portion of the financial guarantee for long-term water management since the IDL may not have the authority to hold such guarantee, and because the BLM land (downgradient of the mine) would be the land most affected without long-term water management. Therefore, any ROD approving a land disposal action alternative would be conditional on TCMC establishing an irrevocable trust fund or other funding mechanism with the IDL for such long-term water treatment or other long-term requirements. The trust fund or funding mechanism would be identical or similar to that required by 43 CFR 3809.552(c) (Section 4.13.4).

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[15] Water treatment is part of reclamation per BLM regulations (e.g., 43 CFR 3809.5), but other agencies may consider reclamation to be limited to traditional "earthworks" such as regrading and re-establishing vegetation.

The BLM, Forest Service, and IDL intend to obtain an updated reclamation cost estimate/financial guarantees from TCMC for the Phase 8 earthworks once an MMPO alternative is approved. However, the BLM intends to obtain an updated reclamation cost estimate/financial guarantee from TCMC to include the costs of long-term water management under the MMPO no action alternative after the release of the FEIS, i.e., when the BLM would first have reasonable confidence in the basic details of the most probable long-term water management plan for the mine. The cost estimate for long-term water management would probably be structured similar to an estimate prepared by the EPA (2013).

1.9.23. Environmental Justice

On February 11, 1994 President Clinton signed Executive Order 12898 directing each Federal agency to make environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high, and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The President also signed a memorandum on the same day emphasizing the need to consider these types of effects during NEPA analysis.

1.10. Permits, Licenses, and Other Entitlements

To implement any of the alternatives in the FEIS, TCMC would need to obtain or renew a variety of permits, licenses, and other entitlements (including consultations and land use plan amendments) (Table 1.10-1.). Notwithstanding, the decisions for which this FEIS was prepared are described in Section 1.6.

Table 1.10-1. Required permits, licenses, and other entitlements.

Permit, License or Entitlement	Description	Authority	Regulatory Agency
Approval of the portion of an MMPO involving BLM land	An operator of a surface mine for locatable minerals must obtain approval for modifications to the MPO (which includes a reclamation plan).	43 CFR 3809	BLM
Approval of the portion of an MMPO involving NFS lands	An operator of a surface mine for locatable minerals must obtain approval for modifications to the MPO (which includes a reclamation plan).	36 CFR 228A	Forest Service

Permit, License or Entitlement	Description	Authority	Regulatory Agency
Approval of the amendment of an approved reclamation plan	An operator of a surface mine in Idaho must obtain approval to amend a reclamation plan, regardless of whether the subject land is private or Federal. If the operating plan submitted to the Federal agency does cover the entire operation (e.g., private lands are not subject to the Federal MPO), the IDL requires an operating plan for that portion of the operations not covered by an MPO administered by a Federal agency.	Idaho Statutes 47-1506 IDAPA 20.03.02.070 IDAPA 20.03.02.090	IDL
Approval of amendments to the Challis RMP	To approve a land disposal alternative, the Challis RMP would first need to be amended to identify the selected land as suitable for disposal under the FLPMA. Other sections of the RMP also might be amended to make it clear that such sections would not apply to the selected land.	43 CFR 1600	BLM
Approval of a land exchange involving BLM land	A proposed land exchange involving BLM land can be completed only with BLM approval.	43 CFR 2200	BLM
CWA Section 404 Permit	The permit is required for the discharge of dredged or fill materials into jurisdictional WUS, including wetlands.	33 CFR 320-330	USACE
ESA Section 7 Consultation	Federal agencies must consult with the US Fish and Wildlife Service for freshwater and wildlife species and with the National Marine Fisheries Service for marine and anadromous species if a proposed action may affect listed species or their designated habitat.	50 CFR 402	US Fish and Wildlife Service; National Marine Fisheries Service
NHPA Section 106 Consultation	Federal agencies must consult with the appropriate State Historic Preservation Officer/Tribal Historic	36 CFR 800	State Historic Preservation Officer

Permit, License or Entitlement	Description	Authority	Regulatory Agency
	Preservation Officer for undertakings that could affect historic properties.		
CWA Section 401 Certification for CWA Section 404 Permit	The IDEQ must grant (with or without conditions), deny or waive 401 certification for any project in Idaho that requires a Federal permit or license under the CWA before the Federal permit or license can be issued. A 401 certification is made to ensure that a proposed project will not violate State water quality standards for surface waters.	33 CFR 325 IDAPA 58.01.02	IDEQ
Construction General Permit (CGP), IDR100000, permit coverage for stormwater discharges from construction activity	Site operators in Idaho engaged in clearing, grading, or excavating activities (including those related to the exploration and construction phases of mining) that disturb one acre or more must obtain a CGP.	40 CFR 122.26	EPA
Point(s) of Compliance for the Groundwater Quality Rule; It is unknown at this time if TCMC will utilize this entitlement	At the request of a mine operator, the IDEQ shall set the point(s) of compliance for the groundwater quality standards outside of the boundary of the mine area, so that there would be no injury to current or projected future beneficial uses of groundwater, and no violations of water quality standards applicable to any interconnected surface waters.	IDAPA 58.01.11	IDEQ
Mine Tailings Impoundment Certificate of Approval	All mine tailings impoundment structures must obtain a certificate of approval, and be recertified every 2 years.	IDAPA 37.03.05	IDWR
Water Dam Certificate of Approval	All regulated water dams must obtain a certificate of approval.	IDAPA 37.03.06	IDWR
Stream Channel Alteration Permit	All work done within the beds and banks of a continuously flowing stream	IDAPA 37.03.07	IDWR

Permit, License or Entitlement	Description	Authority	Regulatory Agency
	in Idaho requires a stream channel alteration permit.		
Air Quality Permit	The IDEQ is in the process of converting the mine's Tier II Air Quality Operating Permit/Permit to Construct into only a Permit to Construct.	IDAPA 58.01.01	IDEQ
NPDES Permit	The EPA is in the process of renewing TCMC's NPDES permit.	Section 402 of the CWA; 40 CFR 122	EPA

1.11. Cooperating Agencies

The BLM is the lead agency for the preparation of the EIS because of the relative magnitude of the potential effects (e.g., areas of surface disturbance, potential downgradient water quality concerns, and the land disposal) to BLM land. However, the EIS was prepared in cooperation with both Federal and State agencies as described below. All of these agencies have both legal jurisdiction and special expertise involving certain aspects of the project. In particular, the Forest Service provided half of the joint Federal interdisciplinary team for the project, as the Forest Service has previously been the lead agency for both of the previous EISs for the mine (Section 1.1.), and NFS land would be affected by the MMPO alternatives. However, only the BLM, Forest Service, and USACE would issue decisions requiring NEPA analysis for the MMPO or land disposal alternatives.

1.11.1. Forest Service

The Forest Service is a Federal land management agency in the US Department of Agriculture. The Forest Service manages Federal land in national forests (NFS lands) and national grasslands. Consequently, the Forest Service has jurisdiction over the portion of the MPO that involves NFS land, and the portion of the MMPO that would involve NFS land. The Forest Service also has special expertise in managing NFS lands, including mining operations, as well as broad expertise in evaluating the environmental effects of a wide range of Federal actions on NFS lands. Approximately 181 acres of the 2,822 acres of currently permitted mine surface disturbance is on NFS land. The expansion of the WRSF, TSF, power line corridor, and pipelines would involve 185 additional acres of NFS land. The Forest Service will issue a separate ROD regarding the MMPO.

1.11.2. USACE

The USACE is a Federal agency in the US Department of Defense. The responsibilities of the USACE include environmental regulation for work in WUS. Specifically, the USACE has jurisdiction over the portion of the MMPO that would involve the discharge of dredged or fill materials into jurisdictional wetland and non-wetland WUS, including rivers, lakes streams (perennial, intermittent and ephemeral), ponds, and man-made canals, ditches and drains, provided that these waters are adjacent to WUS. "Isolated" water bodies are not under the

jurisdiction of the USACE. The USACE also has special expertise in work in the WUS, including erosion control, excess material, floodplains, stream and water body modifications, and wetlands. The USACE will issue an internal decision document regarding the application for a permit under Section 404 of the CWA for the mine.

1.11.3. EPA

The EPA is a Federal agency charged with protecting human health and the environment. The EPA has primary responsibility for implementing Sections 301, 306, 311, and 402 of the CWA, and oversight responsibility for Federal CWA programs delegated to and administered by the IDEQ. In Idaho the EPA also administers the NPDES program, which regulates and grants permits to discharge pollutants to WUS. The NPDES permit for the mine expired January 29, 2007, and has been administratively extended (i.e., is fully effective and enforceable) pursuant to 40 CFR 122.6(a) until the EPA re-issues the permit. Although the re-issuance of the NPDES permit is not subject to New Source Performance Standards or NEPA compliance, the EPA is coordinating permit re-issuance with the project to share information as applicable.

The EPA also has authority under the CWA to review project compliance with Section 404(b)(1) guidelines, and, pursuant to Section 404(c), to veto a permit issued or proposed to be issued by the USACE under Section 404. In practice the EPA may prohibit or withdraw the specification (permitting) of any defined area as a disposal site, and deny or restrict the use of any defined area for specification (including the withdrawal of specification) as a disposal site whenever the EPA determines that use of the site would have an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas, or recreational areas.

In addition to the NEPA compliance responsibilities for the EPA (40 CFR 6), the EPA also has responsibilities under Section 309 of the CWA to review and comment on FEISs by other Federal agencies in accordance with the NEPA. The EPA is a cooperating agency in the development of this FEIS. As a cooperating agency in the EIS development process, the EPA advises lead agencies on the preparation and development of the EIS, and evaluates the adequacy of information and analysis contained therein.

1.11.4. IDEQ

The IDEQ is a State agency with a mission to protect human health and preserve the quality of Idaho's air, land, and water for use and enjoyment today and in the future. The IDEQ is responsible for implementing and enforcing a variety of environmental regulations in Idaho pursuant to various Federal laws (e.g., the CAA) and State laws (e.g., the Environmental Protection and Health Act of 1972, as amended). The IDEQ has special expertise in air quality, water quality, and solid waste management in Idaho, including that related to mining operations. The IDEQ will cooperate with the BLM to ensure that the preferred alternatives in the EIS would be in compliance with all regulations administered by the IDEQ. The IDEQ is also responsible for reviewing permit applications under Section 404 of the CWA for the project, and providing certification for the permits under Section 401 of the CWA.

1.11.5. IDL

The IDL is the State agency responsible for implementing and enforcing regulations for surface mining in Idaho pursuant to the Idaho Surface Mining Act of 1971, as amended. The IDL has

special surface mining expertise in Idaho, and will cooperate with the BLM to ensure that the preferred alternatives in the EIS are in compliance with all regulations administered by the IDL.

1.12. Public Scoping

In accordance with the NEPA, public scoping began August 3, 2010. The purpose of scoping is to inform the public of the project and solicit public and agency comments on the project, thereby incorporating a broader participation and perspective into the analysis and decision-making process for the project. Scoping comments were used to develop issues to be addressed in the EIS, and were also used to refine and/or create alternatives to be analyzed in the EIS.

The Notice of Intent (NOI) to prepare an EIS/RMP amendment was published on August 3, 2010 in the *Federal Register* (75 FR 45652). A BLM website for the project was established concurrently with publication of the NOI (http://www.blm.gov/id/st/en/prog/nepa_register/TCM-exlx_EIS.html), and legal notices for the scoping period and public meetings were published in *The Challis Messenger* (Challis) and *The Idaho Statesman* (Boise) on August 5, 2010 and in *The Idaho Statesman* on April 14, 2010 and in *The Challis Messenger* on April 19, 2010. A BLM press release was also sent to Idaho newspapers, television stations, and radio stations on August 3 and August 11, 2010.

A scoping letter was prepared by the agencies that summarized the MMPO and land exchange proposal, and the NEPA process including public involvement such as public scoping meetings. The scoping letter, a description of the MMPO and land exchange proposal, maps, and a comment form were mailed to 617 potentially interested parties on August 3, 2010. Public scoping meetings were held in Boise on August 23, 2010 and in Challis on August 24, 2010. A formal internal (agency) scoping meeting was previously held in Challis on November 24, 2009 to solicit comments from Federal and State agencies with jurisdiction or interest in the project. By the close of the 30 day scoping period, 188 public responses had been received. In addition, 23 responses were received between September 1 and September 27, 2010 for a total of 211 responses. Some responses had multiple signatures, for a total of 218 respondents (JBR 2011).

A Notice of Exchange Proposal (NOEP) was published in local newspapers during the weeks of April 15, April 22, April 29, and May 6 pursuant to 43 CFR 2201.2. The notice provided an additional public comment period of 45 days for the land exchange proposal. Three respondents provided three responses to the notice, and all of the comments were considered by the BLM (JBR 2013).

Per Executive Order 13175, Government-to-Government tribal consultation was conducted as part of the scoping process. Formal consultation was initiated with the Shoshone-Bannock Tribes on March 8, 2007, regarding the land exchange proposal and RMP amendment. The Tribes were also formally consulted about the land exchange proposal, RMP amendment, proposed MMPO, and proposed 404 permit on March 18, 2009. At that time, the Tribes asked to be involved in the development of a preferred management alternative for the Broken Wing Ranch (part of the offered lands). Consultation with the Tribes is ongoing and included Government-to-Government letters mailed to the Tribes on March 22, 2010 and September 28, 2010. The Tribes submitted comments in a letter dated November 29, 2010. A summary of the

comments is provided in JBR (2011). A Nez Perce Tribe technical staff member was notified about the project in July 2009. The BLM mailed a Government-to-Government letter to the Tribe with extensive project information on March 22, 2010 and asked if the Tribe desired formal Government-to-Government consultation regarding any aspect of the project. A conference call was held on May 12, 2010, among the BLM, Forest Service, and Nez Perce Tribe technical staff to discuss the project. A wide range of issues was discussed; a summary of the key concerns raised by the Nez Perce Tribe technical staff is provided in JBR (2011).

1.13. Issues and Indicators

The issues to be evaluated in this FEIS are described in the Thompson Creek Mine EIS Scoping and Alternatives Analysis report (JBR 2011) and the Notice of Exchange Proposal Content Analysis Report (JBR 2013). These reports organize and summarize the comments received during scoping from the agencies, Native American Tribes, and other members of the public. These public comments were used to define the issues and NEPA measurement indicators for the project.

The issues are presented under the various "components of the human and natural environment" (e.g., fisheries, socio-economic factors, wildlife) that are customarily addressed in the NEPA effects analysis. The indicators are the criteria used to judge the significance of the effect. These criteria are quantitative when feasible and otherwise qualitative. Indicators are based on regulatory requirements, baseline data, trends, and best management technology. A description of the issues and indicators by resource topic is provided below.

1.13.1. Geologic Resources and Geotechnical Issues

Issues related to the proposed MMPO

Issue: Mineral extraction represents an irretrievable loss of the mineral resource.

Indicator:
The millions of pounds of molybdenum that would be removed as a result of the alternatives.

Issues related to the proposed land exchange

Issue: The selected land would no longer be available for saleable, locatable, or leasable minerals entry under Federal laws and regulations.

Indicators:
Acres of land removed from Federal ownership, and the approximate monetary values of minerals (including mining claim maintenance fees) in the selected land based on the mineral potential report; and

Acres of land that would become available to mineral entry.

1.13.2. Soil Resources

Issues related to the MMPO

Issue: The mining operations and related transportation activities would affect soil resources in the project area through disturbance, which may affect post-mining soil productivity.

Indicator:
Acres of soil disturbance created during mining, and acres on which soil would not be re-established by mine reclamation.

Issues related to the land exchange proposal

Issue: Change in management of the selected and offered lands could result in changes to soil such as compaction, productivity, and erosion potential.

Indicator:
Area (acres, or % of parcel) of soil affected by compaction, change in productivity, or relative erosion potential.

1.13.3. Vegetation, Forest Resources, and Invasive and Non-Native Species

Issues related to the MMPO

Issue: The mining operations and related transportation activities may affect vegetation patterns and productivity in the project area, including special status (threatened, endangered, proposed, candidate, or sensitive) plant species habitat.

Indicators:
Acres of vegetation communities and suitable special status habitats that would be disturbed and/or potentially subjected to an increase in weed invasion;

Acres of disturbed area on which vegetation would be re-established during mine reclamation, and the types of vegetation that would be re-established; and

Acres of permanent vegetation conversion from forest to non-forest cover and predicted regrowth rate back to forest conditions.

Issue: Mine expansion would remove timber and decrease carbon sequestration in the project area.

Indicator:
Acres of timber removed and not replaced by mine reclamation. Estimated reduction in annual carbon sequestration compared to US carbon dioxide emissions.

Issues related to the land exchange proposal

Issue: Land leaving Federal ownership may contain special status plant species habitat.

Indicator:
Acres of suitable or known special status plant species habitat on the selected and offered lands.

Issue: The Broken Wing Ranch could be converted to native vegetation.

Indicator:
Acres of cultivated fields that could be converted to native vegetation.

1.13.4. Range Resources

Issues related to the MMPO

Issue: Mine expansion would occur on lands currently permitted for livestock grazing.

Indicators:
Acres of suitable livestock grazing lands on the selected and offered lands; and

Animal Unit Months (AUMs) of forage on the selected and offered lands.

Issue: The BLM would no longer make the Thompson Creek allotment available to grazing.

Indicators:
Acres of suitable livestock grazing land that would become unavailable if the Thompson Creek allotment were unavailable to grazing under permit from the BLM; and

AUMs of forage that would become unavailable if the Thompson Creek allotment were unavailable to grazing under permit from the BLM.

Issues related to the land exchange proposal

Issue: Disposal of selected land may affect permitted livestock grazing within and adjacent to the project area; the BLM might not make the Broken Wing Ranch available to grazing.

Indicators:
Acres of suitable livestock grazing lands on the selected and offered lands;

AUMs of forage on the selected and offered lands; and

Effects to permitted livestock grazing adjacent to the project area, e.g., access.

1.13.5. Water Resources

Issues related to the MMPO

Issue: The mine may cause long-term changes to the quantity and quality of surface water or groundwater in the project area, i.e., within the Thompson Creek and S. Creek watersheds and in the Salmon River.

Indicators:
Estimated turbidity, concentrations of suspended sediment, and concentrations of constituents of concern (COCs) in downgradient streams, ponds, and other surface waters (including effects to surface waters from groundwater) caused by mining compared to applicable surface water quality standards;

Estimated concentrations of COCs in ground water under and downgradient of the pit lake, TSF, and WRSFs compared to applicable groundwater quality standards;

Change in the amount or distribution of surface water discharge (cubic feet/second [cfs]) caused by mining; and

Change (increase or decrease) in groundwater quantity caused by mining.

Issue: TCMC may need additional or modified water quality permits due to the mine expansion.

Indicator:
Modifications to existing or additional water quality permits due to the MMPO alternatives.

Issue: Mine expansion may affect current water rights.

Indicator:
Change in available water (cfs) for water users.

Issues related to the land exchange proposal

Issue: If the BLM acquires the Broken Wing Ranch, there could be changes in the water rights associated with the ranch.

Indicator:
Change in cfs of the water rights that would remain associated with the Broken Wing Ranch if the ranch were acquired by the US.

1.13.6. Wildlife Resources

Issues related to the MMPO

Issue: The mining operations may physically affect terrestrial wildlife, including special status and Management Indicator Species (MIS), through disturbance and fragmentation of their habitat.

Indicators:
Acres of different wildlife habitats physically disturbed and the projection of that disturbed habitat over the life of proposed mining activities;

Acres of disturbance to and the proximity of the proposed mining operations to high value habitats such as special status species habitat, crucial and or high value big game ranges, wetlands, and seep and spring areas;

Acres of disturbance to habitat used for migration and the potential for migration to be affected;

Potential uptake by wildlife of COCs in mining disturbed areas and areas that are reclaimed (in qualitative terms);

Changes in water quantity (cfs) or quality (constituent concentration) caused by mining in wildlife habitat;

Increase in mining and transportation related noise levels (in decibels) within or in proximity to wildlife habitat; and

Increase in vehicle traffic in the project area (in average trips per day, month, or year) and potential for increased wildlife mortality through accidents.

Issue: The filling of the pit with water following reclamation may affect birds and other wildlife if the pit lake water does not meet applicable water quality standards for wildlife habitat. The pit lake may also entrap some wildlife seeking access to the water.

Indicators:
Change in use of the area by birds (increase in surface water area); and

Anticipated COCs of concern in pit water compared to applicable surface water standards.

Issues related to the land exchange proposal

Issue: Disposal of selected land may result in the known or suitable special status or MIS habitat leaving Federal ownership and management.

Indicator:
Acres of known or suitable special status or MIS habitat on the selected and offered lands.

Issue: Transfer of the selected land to private ownership may create a refuge from hunting for wildlife with wildlife concentrating in these areas, particularly during hunting seasons. Such refuge may negatively affect vegetation and lead to increased mortality (wildlife and human) due to motor vehicle collisions.

Indicator:
Estimated change in hunting pressure on the selected and offered lands.

1.13.7. Fish and Aquatic Resources

Issues related to the MMPO

Issue: The mine may affect bull trout, Chinook salmon, steelhead trout, and sockeye salmon individuals as well as critical habitat (for threatened and endangered species). It may also affect westslope cutthroat trout, other native fish, amphibians, or aquatic resources in the project area.

Indicators:
Changes in the National Marine Fisheries Service (NMFS) indicators of properly functioning condition (PFC);

The length of intermittent and perennial stream channels directly affected by waste rock and tailings disposal, road fill and associated culverts, and comparison with the undisturbed lengths of these stream channels in the project area;

Changes in stream discharge (cfs) caused by mining; and

Estimated concentrations of suspended sediment and COCs in water supporting fishery resources in the area, with emphasis on compliance with applicable aquatic life water quality standards.

Issues related to land exchange proposal

Issue: The land exchange may result in changes in ownership and management of known critical habitat for bull trout, Chinook salmon, steelhead trout, and sockeye salmon (threatened or endangered species). It may also affect suitable habitat for westslope cutthroat trout, other native fish, amphibians, or other aquatic resources in the project area.

Indicator:
Acres and quality of critical habitat for bull trout, Chinook salmon, steelhead trout, and sockeye salmon (threatened or endangered species) and acres of known or suitable special status or MIS habitat on the selected and offered lands.

1.13.8. Wetlands, Floodplains, and Riparian Areas

Issues related to the MMPO

Issue: The proposed MMPO would result in direct effects to wetlands within the mine footprint as a result of tailings, overburden fills, and other surface disturbance.

Indicator:
The number of wetland acres lost by proposed mining activities.

Issue: The proposed MMPO could result in indirect effects to wetlands downslope of disturbance within the mine footprint.

Indicators:
Changes in downslope wetland water quality (e.g., increased metal or sediment loading) or quantity (surface or groundwater) as a result of actions within the mine expansion footprint; and

In downslope wetlands, concentration of COCs remaining in growth medium after the TSF is reclaimed compared to applicable standards and guidelines.

Issues related to the land exchange proposal

Issue: The land exchange may result in changes in ownership and management of wetland areas providing high value plant and wildlife habitat.

Indicator:
Acres of wetlands that would be removed from or enter BLM administration.

1.13.9. Air Quality, Noise, and Climate Change

Issues related to the MMPO

Issue (air): Mine emissions may cause air quality effects that are different from existing operations due to relocation of mining emissions and from increased traffic on haul roads and possibly off-site access roads.

Indicator (air):
Quantities of exhaust and dust generated from haul trucks and other mining equipment and their effects on air quality in IDEQ air quality control regions (AQCRs).

Issue (noise): Noise from mining operations including traffic on haul roads and traffic on access roads may increase under the MMPO.

Indicator (noise):
Estimated noise levels, in decibels, from mining operations including haul truck traffic related to mining and access road traffic.

Issues related to the land exchange proposal

Issue (air): There would be a change in air quality at the Broken Wing Ranch due to changes in management.

Indicator (air):
Qualitative changes in air quality at the ranch.

Issue (noise): The Broken Wing Ranch and the Lyon Creek drainage would have increased noise if the ranch were administered by the BLM.

Indicator (noise):
Qualitative changes in noise at the ranch and in the Lyon Creek drainage.

1.13.10. Visual (Aesthetic) Resources

Issues related to the MMPO

Issue: The mine may affect visual resources in the area, both during and after production.

Indicators:
Compliance with the visual quality objectives (VQOs) in the Forest Service visual resource management (VRM) system;

Compliance with the VRM classes in the BLM VRM system; and

Change in the characteristic landscape of the mine area, from baseline to projected, from various public and private meaningful viewpoints.

Issues related to the land exchange proposal

Issue: The land disposal may cause a change in the visual aesthetics of the offered lands.

Indicator:
Changes in scenery from various public and private key viewpoints of the offered lands.

1.13.11. Land Use and Recreation

Issues related to the MMPO

Issue: Recreational use and public access to the project area may be limited or prevented by mining activities and could affect adjacent private land.

Indicators:
Acres of Federal land closed to public use by mining;

Number of recreational access points closed to the public use by mining;

Acres of recreational areas blocked from public access by mining;

Locations of primary access roads or trails blocked or closed by mining; and

Changes in the Forest Service Recreation Opportunity Spectrum (ROS) classification or the BLM settings matrix.

Issue: Mine expansion may affect inventoried roadless areas (IRAs) or areas with BLM Wilderness Characteristics.

Indicators:
Acres of IRA or areas with wilderness characteristics that would be directly affected by mining; and

Changes to roadless characteristics and wilderness attributes.

Issues related to land exchange proposal

Issue: Recreational use and public access may change on lands proposed for disposal and acquisition through the land exchange.

Indicators:
Acres of BLM, NFS, and private land available for public use after the proposed land exchange;

Acres of land available to recreational use through conservation easements and other mitigation measures included in the action alternatives as a subset of previous indicators;
Acres of land accessible to motorized and non-motorized users after the proposed land exchange; and

Change in the type of recreational use as a result of the land exchange.

Issue: Lands involved in an exchange may be used for purposes that are different from the past, e.g., the BLM might not make the Broken Wing Ranch available for agriculture or grazing.

Indicator:
Change in use of the selected and offered lands.

Issue: The land exchange may create user conflict with private landowners adjacent to lands proposed for disposal and acquisition and could devalue adjacent private lands.

Indicator:
Changes in use and value of private lands adjacent to the selected and offered lands due to the land exchange.

Issue: The land exchange would affect agricultural production on the offered lands and increase administrative costs.

Indicator:
Change in agricultural production and BLM administrative costs related to the selected and offered lands.

Issue: The land exchange would result in a net decrease in BLM land.

Indicator:
Acres of BLM land that would become private and vice versa for the land disposal alternatives.

1.13.12. Socioeconomic Factors

Issues related to the MMPO

Issue: Decreased production or closure of the mine would have effects on local, State, and national economies.

Indicators:
Numbers of employees, contractors, and their dependents that could be affected by potential mine closure; and

Changes in mine payroll, personal income, personal taxes, and tax revenues after mine closure. Indirect effects would typically be calculated using appropriate multipliers.

Issue: Decreased job opportunities and economic stability from decreased production or mine closure would affect social conditions in local communities.

Indicators:
Change in the number of jobs and the salary and wages of jobs in the affected communities; and

Changes in common demographic factors. Indirect effects would typically be calculated using appropriate multipliers.

Issue: The mine production affects the supply and price of molybdenum on the world market.

Indicator:
Millions of pounds molybdenum that would be produced by the mine under the MMPO alternatives compared to US and world molybdenum supply.

Issue: The mine production affects the reliance of the US on foreign sources of molybdenum.

Indicator:
Millions of pounds of molybdenum that would be produced by the mine under the MMPO alternatives compared to US and world molybdenum supply, reserves and resources.

<u>Issues related to the land exchange proposal</u>

Issue: The land exchange would change property tax revenues for Custer County and have economic effects on local communities.

Indicators:
Changes in tax revenue for Custer County for the land disposal action alternatives; and

Changes in tax revenue and both quantitative (dollars) and narrative descriptions of other economic effects to the local community, including effects from changes in ranching and agricultural activities at the Broken Wing Ranch and effects to schools, utilities, fire/police departments, schools, etc.

Issue: The land exchange would affect BLM revenues from the selected land.

Indicator:
Change in revenue collected from the selected land by the BLM.

Issue: The land exchange would affect BLM revenues from the selected land.

Indicator:
Change in revenue collected from the selected land by the BLM.

Issue: BLM administration of the Broken Wing Ranch would alter the culture of Custer County.
Indicator:
Changes in the culture of Custer County.

1.13.13. Financial Assurance

Issues related to the MMPO

Issue: The current reclamation bond may not be adequate to cover the MMPO as proposed.

Indicator:
Description of the determination and collection of financial guarantees by the BLM, Forest Service, and IDL for the proposed MMPO with reference to the appropriate regulations, the timing of reclamation cost estimation by the operator, items generally included in the estimate, and the agency review and approval process.

Issues related to the land exchange

Issue: The regulatory environment of the mine would change as a result of the land disposal, i.e., the Idaho Administrative Code Rules 20.03.02 would govern the portion of the mine not governed by the BLM surface management regulations at 43 CFR 3809. More specifically, there could be a different frequency of agency inspections, and different financial guarantee requirements for long-term water treatment related to the MMPO, etc.

Indicator:
Narrative description of the specific regulatory changes that would result with the land disposal alternatives.

1.13.14. Tribal Treaty Rights and Interests

Issues related to the MMPO

Issue: The mine activities may affect the ability of Shoshone-Bannock and Nez Perce Tribal members to exercise their treaty rights in the project area and may affect resources of cultural significance to Tribal members.

Indicators:
Quantity and quality of cultural resource sites that may be of significance to Tribal members that could be affected by the MMPO or land disposal alternatives;

Acres of unoccupied Federal land;

Acres of land within the ceded boundary of the Fort Hall Indian Reservation;

Acres of land with Shoshone-Bannock Tribal grazing rights; and

Known prehistoric cultural resources sites affected by the MMPO and land exchange alternatives.

Issue: The mine could cause health risks to tribal members due to consumption of water, fish, and wildlife.

Indicator:
Exceedances of the concentrations of potential COCs in water, fish, and wildlife above standards for human health.

1.13.15. Cultural Resources

Issues related to the MMPO and land exchange proposal

Issue: Cultural resource sites may be affected in the project area on the selected and offered lands.

Indicator:
Number and quality of cultural sites eligible for the NRHP affected by the MMPO and land disposal alternatives.

Issue: The heritage values (resources) of the project area may be compromised by the mine expansion or land exchange.

Indicators:
Acres of selected and offered lands removed from historic land uses; and

Acres of offered land with local heritage value.

1.13.16. Transportation, Access, and Public Safety

Issues related to the MMPO

Issue: There is the potential for spills of molybdenum concentrate during shipment due to traffic accidents.

Indicators:
Number of accidents in the past and the fate of spilled molybdenum concentrate; and
Estimation of future number of molybdenum concentrate spills and their fate during shipment.

Issues related to the land exchange proposal

Issue: The land exchange may affect existing access for grazing allotment permittees, recreationalists, and other members of the public.

Indicators:
Narrative description of changes in access to grazing allotments under the land disposal alternatives; and

Narrative description of changes in access to Federal land (motorized and non-motorized).

1.13.17. Hazardous Materials and Solid Waste

Issues related to the MMPO

Issue: Contamination of water, soil, and air could occur due to petroleum or other chemical spills and on-site disposal of solid waste.

Indicator:
Narrative description of the threat of releases of petroleum or hazardous substances and their sources.

Issues related to the land exchange proposal

Issue: There would be a greater chance for the release of petroleum or hazardous substances and dumping of solid waste on the Broken Wing Ranch.

Indicator:
Narrative description of the threat of releases of petroleum or hazardous substances and their sources.

1.14. Issues Considered But Not Analyzed Further

Under Executive Order (Section 1.9.23.), each Federal agency makes environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The BLM considers these types of effects during NEPA analysis. However, none of the MMPO and land disposal alternatives would disproportionately affect minority or low-income populations, and so environmental justice concerns are not discussed further in the FEIS.

CHAPTER 2

PROPOSED ACTIONS AND ALTERNATIVES

CHAPTER 2 – PROPOSED ACTIONS AND ALTERNATIVES

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2.0. PROPOSED ACTIONS AND ALTERNATIVES

Chapter 2 describes the alternatives for the project, including those that were considered but not fully analyzed. The alternatives are organized as a set of MMPO alternatives (Alternatives M1 through M3) and a set of land disposal alternatives (Alternative L1 through L5). The agency-preferred alternative for each set is identified. The MMPO alternatives are independent (do not depend on the outcome) of the land disposal alternatives as the mine would not operate differently if TCMC acquired the selected land, which contains the southern portion of the mine. The range of alternatives considered in an EIS are based on the proposed actions (Alternative M2 for the MMPO alternatives and Alternative L2 for the land disposal alternatives) and the purpose and needs of the lead agency (or agencies) as well as by considering issues identified by other agencies and through public scoping. The range of alternatives to be evaluated in an EIS should meet certain key principles including the following:

- All action alternatives considered for analysis in an EIS should achieve the objectives of the Federal agency's purpose and need for the project;
- The overall range of alternatives should be governed by the "rule of reason." When there are potentially a large number of alternatives, only a reasonable number, covering a full spectrum need be analyzed in an EIS;
- Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply being desirable from the standpoint of the applicant;
- Alternatives that are speculative and geographically remote need not be considered; and
- Alternatives with environmental effects that have greater environmental effect (common sense basis) than the action(s) proposed by the applicant or other alternatives under consideration can be eliminated from analysis.

The BLM, Forest Service, and USACE are responsible for issuing decisions regarding the MMPO (the USACE will issue a decision on a 404 permit application necessary for TCMC to implement the MMPO), and the BLM is responsible for issuing a decision for the land disposal alternatives/RMP amendment. The NEPA requires the lead agency(s) to identify the preferred alternative in a draft EIS if one is known. The BLM- and Forest Service-preferred MMPO alternative is Alternative M2, and the BLM-preferred land disposal alternative is Alternative L2, with the RMP amended to allow the disposal of the selected land. These agency-preferred alternatives were identified by the agencies after they considered which alternative in each set would best fulfill its statutory mission and responsibilities given economic, environmental, and technical factors.

2.1. MMPO Alternatives

The agency objectives used to guide the MMPO alternatives include the following:

- Ensure compliance with relevant Federal and State laws and regulations;
- Ensure compliance with the BLM and Forest Service land use plans;
- Minimize effects on surface and groundwater quantity and quality;
- Minimize surface disturbance;
- Provide for reclamation that returns disturbed areas to stable, natural vegetation communities as quickly as practicable;
- Minimize waste that would require treatment or disposal;
- Address uncertainties to minimize long-term risks to the environment; and,
- Ensure that monitoring and reporting requirements allow efficient and effective oversight of mining operations.

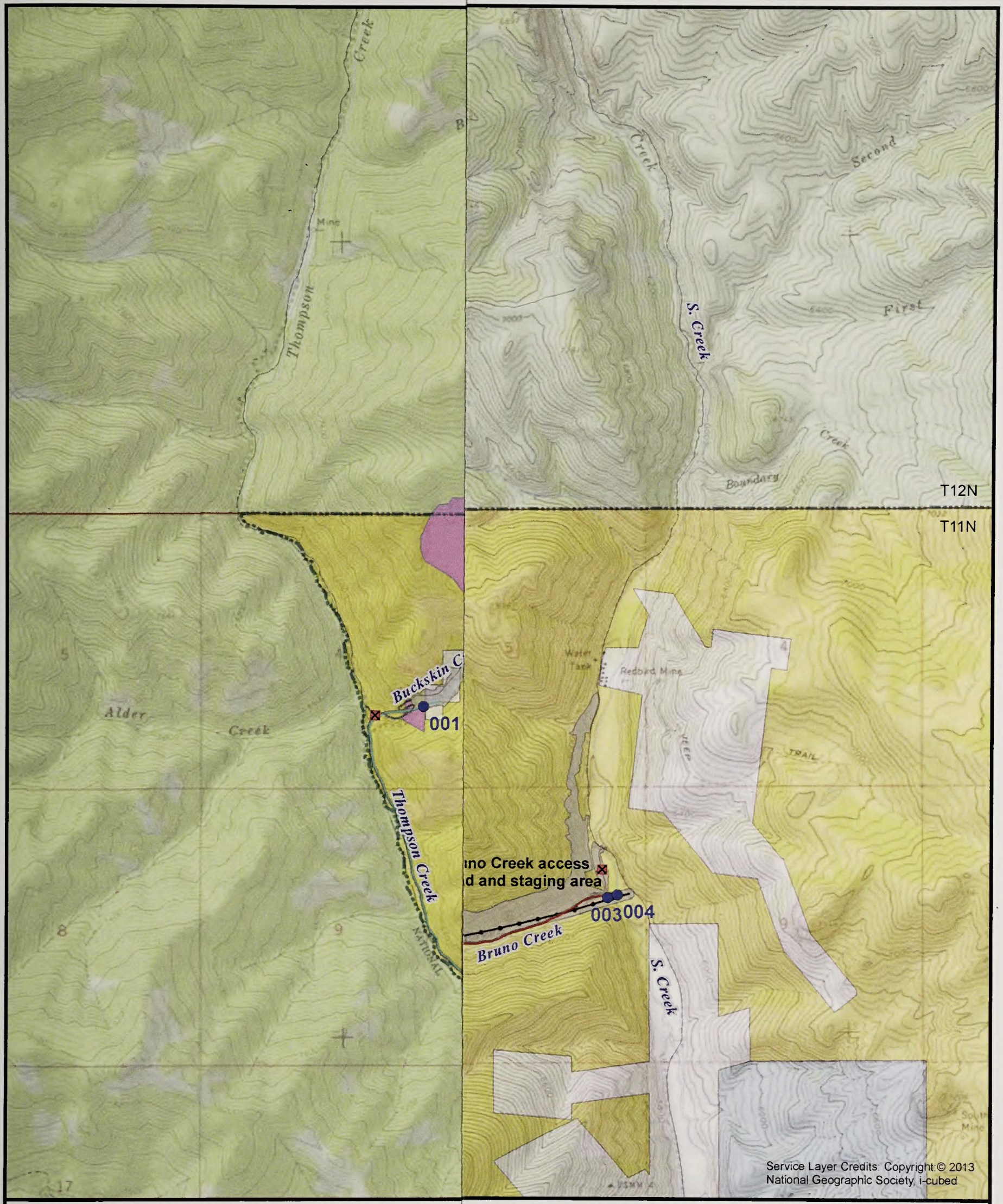
The mine is currently permitted to complete Phase 7 (Alternative M1 – No Action). The MMPO submitted by TCMC in October 2009 would allow the completion of Phase 8 (Alternative M2 – MMPO as submitted by TCMC). Alternative M3 (No Name WRSF) is generally the same as Alternative M2, except the No Name WRSF would be included within the overall configuration of the WRSFs and the Buckskin and Pat Hughes WRSFs would have correspondingly smaller final footprints. The core mine operations (e.g., molybdenum production rate and reclamation measures) are essentially the same in all of the MMPO alternatives. Therefore, the core operations are outlined separately (Section 2.1.1.) to allow the reader to focus on the portion of each alternative within the Federal "decision space" (i.e., overburden (waste rock) and tailings storage, long-term water management, and a power line relocation). Note that the description of Alternative M1 is necessarily a brief summary of the currently approved MPO (i.e., the 1979 MPO as modified during the last 30 years), which includes the reclamation plan (or from the perspective of the IDL, the 1999 Consolidated Reclamation Plan which includes the portion of the operating plan for the private land at the mine, as amended). In the event of a discrepancy between the summary of the MPO in this FEIS and the MPO, the MPO is the authoritative document. The same is true for the summary of the MMPO (Alternative M2) in the FEIS.

2.1.1. Features Common to All MMPO Alternatives

This section describes the existing facilities, operations, and environmental management at the mine which would be common to all alternatives. The reclamation of the mine would generally be the same under all alternatives, except for the differences described in Section 2.1.3.6., Section 2.1.4., and Section 2.1.1.8.

2.1.1.1. General Facilities

The mine operations are supported by a variety of ancillary facilities and personnel. The support facilities include maintenance shops, warehouses, change houses, and administrative offices (Figure 2.1-1).



ciences.

Legend

- Existing mining disturbance
- Permitted but undisturbed
- NPDES outfall
- Gate
- Existing mine structures
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Figure 2.1-1
MMPO Alternative M1 - No Action
Thompson Creek Mine EIS

- Ensure compliance with relevant Federal and State laws and regulations;
- Ensure compliance with the BLM and Forest Service land use plans;
- Minimize effects on surface and groundwater quantity and quality;
- Minimize surface disturbance;
- Provide for reclamation that returns disturbed areas to stable, natural vegetation communities as quickly as practicable;
- Minimize waste that would require treatment or disposal;
- Address uncertainties to minimize long-term risks to the environment; and,
- Ensure that monitoring and reporting requirements allow efficient and effective oversight of mining operations.

The mine is currently permitted to complete Phase 7 (Alternative M1 – No Action). The MMPO submitted by TCMC in October 2009 would allow the completion of Phase 8 (Alternative M2 – MMPO as submitted by TCMC). Alternative M3 (No Name WRSF) is generally the same as Alternative M2, except the No Name WRSF would be included within the overall configuration of the WRSFs and the Buckskin and Pat Hughes WRSFs would have correspondingly smaller final footprints. The core mine operations (e.g., molybdenum production rate and reclamation measures) are essentially the same in all of the MMPO alternatives. Therefore, the core operations are outlined separately (Section 2.1.1.) to allow the reader to focus on the portion of each alternative within the Federal "decision space" (i.e., overburden (waste rock) and tailings storage, long-term water management, and a power line relocation). Note that the description of Alternative M1 is necessarily a brief summary of the currently approved MPO (i.e., the 1979 MPO as modified during the last 30 years), which includes the reclamation plan (or from the perspective of the IDL, the 1999 Consolidated Reclamation Plan which includes the portion of the operating plan for the private land at the mine, as amended). In the event of a discrepancy between the summary of the MPO in this FEIS and the MPO, the MPO is the authoritative document. The same is true for the summary of the MMPO (Alternative M2) in the FEIS.

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2.1.1.1. General Facilities

The mine operations are supported by a variety of ancillary facilities and personnel. The support facilities include maintenance shops, warehouses, change houses, and administrative offices (Figure 2.1-1).

R16E R17E

T12N

T11N

Buckskin Waste Rock Storage Facility

Open Pit

Tailings Storage Facility

SRD

Shops/ Crusher/ Office

PWTP

Mill

Pat Hughes Waste Rock Storage Facility

Cherry Creek Pump Station

001

002

003004

005 (Downstream to Thompson Creek and Salmon River Confluence)

Bruno Creek access road and staging area

Buckskin Creek

Thompson Creek

Thompson Creek Road

No Name Creek

Pat Hughes Creek

Cherry Creek

Bruno Creek

Redbird Creek

Mill Creek

S. Creek

Alder Creek

Basin Creek

Second Creek

First Creek

Boundary Creek

Twin Apex Mine

Redbird Mine

Water Tank

Service Layer Credits: Copyright © 2013 National Geographic Society, i-cubed

Legend

- Existing mining disturbance
- Permitted but undisturbed
- NPDES outfall
- Gate
- Existing mine structures
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

0 1:32,000 1
Miles

0 1
Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.1-1
MMPO Alternative M1 - No Action
Thompson Creek Mine EIS

The mine infrastructure includes systems to supply and store process and potable water, to dispose of solid waste, to treat sewage and process water, and to distribute electrical power. Personnel not directly involved in mining and ore processing perform management, safety, security, engineering, equipment and facility maintenance, environmental compliance monitoring, accounting, purchasing, human resources, and various other tasks. TCMC employs 379[1] full-time workers at the mine and operates 24 hours per day, 365 days per year.

2.1.1.2. Transportation, Access, and Power

The primary access road to the mine is via the S.[2] Creek Road at milepost (MP) 219.6 on State Highway (SH) 75. The S. Creek Road leads 4.1 miles north along S. Creek to the confluence of S. and Bruno creeks where there is a staging area and a remotely controlled security gate. The mine is reached by traveling 5.0 miles past the gate (exclusive TCMC access) on the Bruno Creek access road. TCMC provides road maintenance and dust control for the section of S. Creek Road that leads to the mine and for the Bruno Creek access road, as well as all other mine access roads.

TCMC accesses three outlying facilities in the Thompson Creek drainage via the Thompson Creek Road, which begins from SH 75 at MP 215.6: the Cherry Creek pump station, Pat Hughes WRSF, and Buckskin WRSF (Figure 2.1-1). TCMC has exclusive easements for the access roads from Thompson Creek Road to these facilities, and access to these facilities is controlled by gates, respectively, at MP 2.9, MP 4.1, and MP 6.8 on Thompson Creek Road. TCMC also owns the bridge across the Salmon River on the Thompson Creek Road, and owns (and controls with a gate) the lower portion of the road which is on property owned by TCMC.

The Salmon River Electric Cooperative supplies the mine electric power from the Bonneville Power Administration. The power is transmitted by a 230-kV power line from the Spar Canyon substation to the South Butte substation, where the power is then transmitted by a 69-kV power line to the mill. The mine uses approximately 160 million kilowatt-hours (kW-hr) per year, with a monthly peak use of approximately 15.6 to 15.7 million kW-hr (22 megawatts). TCMC pays approximately $6 million to $7 million annually for the electricity.

The existing power line, pipeline, road, and fiber optic networks require maintenance and possible replacement of equipment during the mine life and, in some cases, until the end of mine reclamation. Trees are removed from the power line corridors for fire protection and to avoid damage. All of the transportation and utility corridors required by the mine are authorized by the MPO under Federal mining laws. However, TCMC has chosen to also obtain rights-of-ways (and pay annual fees) under the FLPMA for some of these corridors.

---

[1] TCMC temporarily reduced its workforce from 379 employees to 274 in October 2012 (TCMC 2012a); a similar number of employees would be hired back when Phase 8 overburden removal resumes.

[2] *Squaw Creek* is an official place name in Custer County, and appears in numerous published documents including US Geological Survey topographic maps. The name was established by the US Board of Geographic Names to maintain uniform geographic name usage throughout the Federal Government. However, the word *Squaw* is offensive to some people including the Shoshone-Bannock Tribes. Therefore, *Squaw Creek* is hereafter referred to in the main text as *S. Creek*.

2.1.1.3. Mining Operations

The mine is a conventional open pit hard rock mine (Photo 2.1-1.), utilizing drilling and blasting to fragment the rock; electric shovels to excavate waste rock and ore (Photo 2.1-2.); off-road diesel haul trucks (Photo 2.1-3.) to transport ore and waste rock from the open pit to the crusher or WRSFs, respectively. At the end of Phase 7, the pit, at its largest diameter, would be 5,700 feet long and 5,150 feet wide, and the base of the pit would be at an elevation of 6,350 feet. Measured from its highest (8,600 feet) to lowest point the pit would be 2,250 feet deep.

The waste rock is analyzed to determine its sulfur concentration, acid generation potential (AP), and neutralization potential (NP). Overburden and waste rock with an NP:AP ratio greater than or equal to 1.5:1 and sulfur concentration less than or equal to 0.10 percent is classified as non-acid generating (Type 1) and can be disposed of anywhere in either WRSF. Waste rock with an NP:AP ratio less than 1.5:1 and sulfur concentration greater than 0.10 percent is classified as potentially acid-generating (Type 2), and is placed in either the Pat Hughes WRSF or a designated part of the Buckskin WRSF (Figure 2.1-1).

Ore is crushed in the primary gyratory crusher and moved to the mill coarse-ore stockpile via an overland conveyor 7,200 feet in length (Photo 2.1-4., Photo 2.1-5., Photo 2.1-6). The crusher and conveyor operate at 1,854 tons per hour, and the coarse ore stockpile has a basic capacity of 75,000 tons (~ 3 day supply, but can be expanded to 220,000 tons with a bulldozer). The stockpile, exposed on a windy ridge, is surrounded by a mesh wind fence to reduce fugitive dust.

The mine has cumulatively produced approximately 390 million pounds of molybdenum from 1983 to 2011 (end of Phase 6). The mine typically produces 15 to 20 million pounds of molybdenum each year, but had no production in 1993, and produced only 5 to 10 million pounds of molybdenum during some years. The mine had a record production in 2010 of 25.3 million pounds of molybdenum. TCMC was in full production mining and milling approximately 30,000 tons per day of ore until the end of 2014 when the last of the Phase 7 ore will be milled. At that point the mine will enter a slowdown with no molybdenum production (Challis Messenger 2014, Thompson Creek Metals Company 2014). Approximately 110,000 tons per day of overburden are typically removed during periods of overburden removal. However, during the slowdown there will be only limited Phase 8 overburden removal and storage on private property. The mine life would vary between Alternative M1 and the other MMPO alternatives, but ore, waste rock, and molybdenum production rates would be the same each year for all MMPO alternatives.

A great deal of overburden (waste rock) overlies the ore body and needs to be removed from top down to expose the underlying ore. Through mine designs and planning, overburden and ore are removed from the open pit in phases such that the pit is continually widened and deepened. Each subsequent overburden (stripping) phase thus comprises a larger volume of waste rock and requires longer to remove. For example, Phase 6 overburden consisted overall of removing a slice of waste rock approximately 250 feet wide and 1,850 feet high (from an upper average elevation of approximately 8,200 feet to a lowermost elevation of 6,350 feet), and had an overall duration of approximately 4 years (August 2007 to December 2011).



Photo 2.1-1. Open pit (June 2011).
Phase 6 ore extraction from the bottom of the pit completed, and Phase 7 stripping along the northeast highwall. View to southeast.



Photo 2.1-2. Electric shovel, 40 cubic yard bucket.



Photo 2.1-3. Haul trucks, 200 tons.



Photo 2.1-4. Primary crusher being fed by haul trucks loaded with ore.
The crusher feeds crushed ore (less than 8 inches in diameter) to the conveyor which is approximately 75 feet underground at this point. View to east.

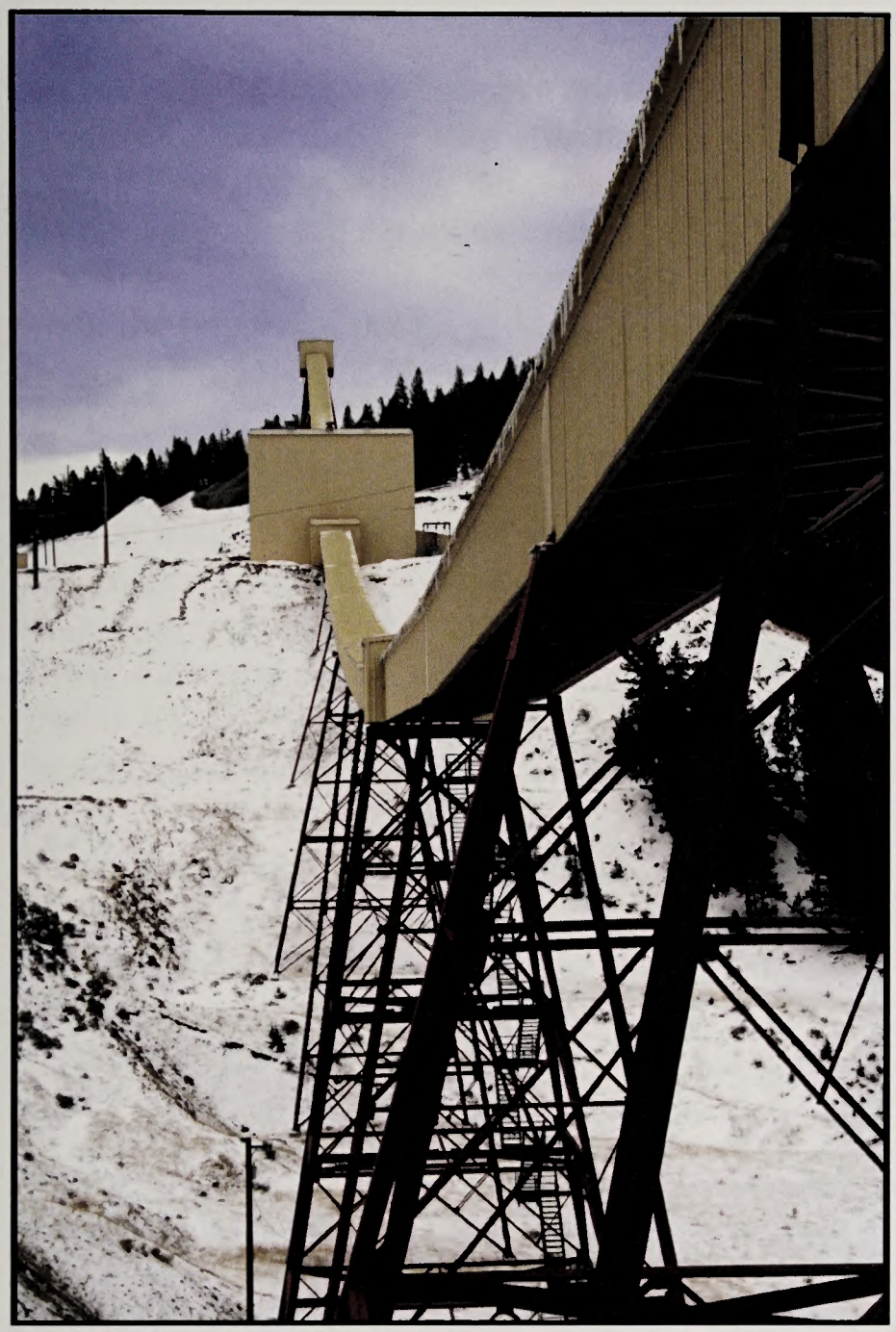


Photo 2.1-5. Overland belt conveyor to mill coarse ore stockpile, view to east.



Photo 2.1-6. Conveyor and, in foreground, coarse ore stockpile and mill.
Conveyor angles northward around hillside in photo center. View to west.

The waste rock and ore of each phase are removed in layers (benches) 50 feet high and up to 75 feet wide. After two benches are removed ("double benching"), the next two benches are removed. The result is a stair-step pattern of catch benches to help maintain the pit walls and prevent long-distance rock fall. The narrower (35 feet) catch bench widths produce an overall steeper wall in more competent rock (e.g., granitic), and the wider (75 feet) widths produce an overall shallower wall in less competent (e.g., volcanic) rock. TCMC completed mining Phase 6 ore in the bottom of the pit in May 2011. TCMC subsequently used stockpiled Phase 6 ore until the end of 2011 when Phase 7 stripping was completed and Phase 7 ore production began.

2.1.1.4. Waste Rock Storage Facilities

The Pat Hughes WRSF contained approximately 220 million tons of mostly (85 %) Type 2 waste rock at the end of 2010. Approximately 10 million tons of Type 2 waste rock and a stockpile of 17 million tons of Type 1 waste rock were added to the facility in 2011 and 2012. The Buckskin WRSF currently contains approximately 420 million tons of waste rock (~ 74 % Type 1) (Photo 2.1-7., Photo 2.1-8). The Type 2 waste rock in the Buckskin WRSF is not segregated because it was added to the facility before regulations required such segregation.

A sub-drain was constructed in the Pat Hughes and Buckskin drainages prior to the placement of the waste rock. The sub-drains pass the estimated maximum flow in each drainage and are designed to function even after the facilities are completed. The Pat Hughes drain is a French drain with layers of sized coarse and durable rock. The Buckskin drain is a perforated culvert packed with coarse durable rock.



Photo 2.1-7. Buckskin and Pat Hughes WRSFs.
Pat Hughes WRSF (circled lower left), Buckskin WRSF (circled upper left center), view to northwest.



Photo 2.1-8. Pat Hughes WRSF.
View to south from the top of the facility showing active face at the south end of the facility (cross-valley fill).

2.1.1.5. Mill and Tailings Operations

Samples of drill cuttings are assayed prior to blasting to differentiate ore from waste rock, classify the waste rock (Type 1 or Type 2), and determine the grade of the ore. Ore from the pit is hauled by truck to the primary crusher, where it is reduced in size then transported to the mill and concentrator facility by an overland belt conveyer. The mill is fed by drawing from the bottom of the coarse-ore stockpile. At the mill the crushed ore is finely ground and mixed with water in semi-autogenous grinding (SAG) mills and ball mills (Photo 2.1-9). The ground ore/water slurry is placed in a series of cells with flotation reagents which cause the molybdenite particles to float to the surface and the waste material to sink to the bottom (Photo 2.1-10., Photo 2.1-11). A portion of the molybdenite concentrate is further concentrated to a very high purity (the percentage varies and is often customer-driven), ground to very precise particle sizes, and sold as high performance molybdenum for use as a high temperature lubricant and in specialized chemical applications. The remaining molybdenite concentrate is dried, bagged, and shipped to the Langeloth, Pennsylvania conversion plant where the concentrate is converted to technical grade molybdenum trioxide. Small additions of molybdenum trioxide during the production of steel, greatly improves the strength and durability of the steel. Most of the molybdenum trioxide is utilized in that form, but some is further converted to ferromolybdenum or pure molybdenum metal. The mine has historically recovered 88 to 90 percent of the molybdenum in the ore, but the current recoveries are approximately 92 percent and would be the same for all of the MMPO alternatives.

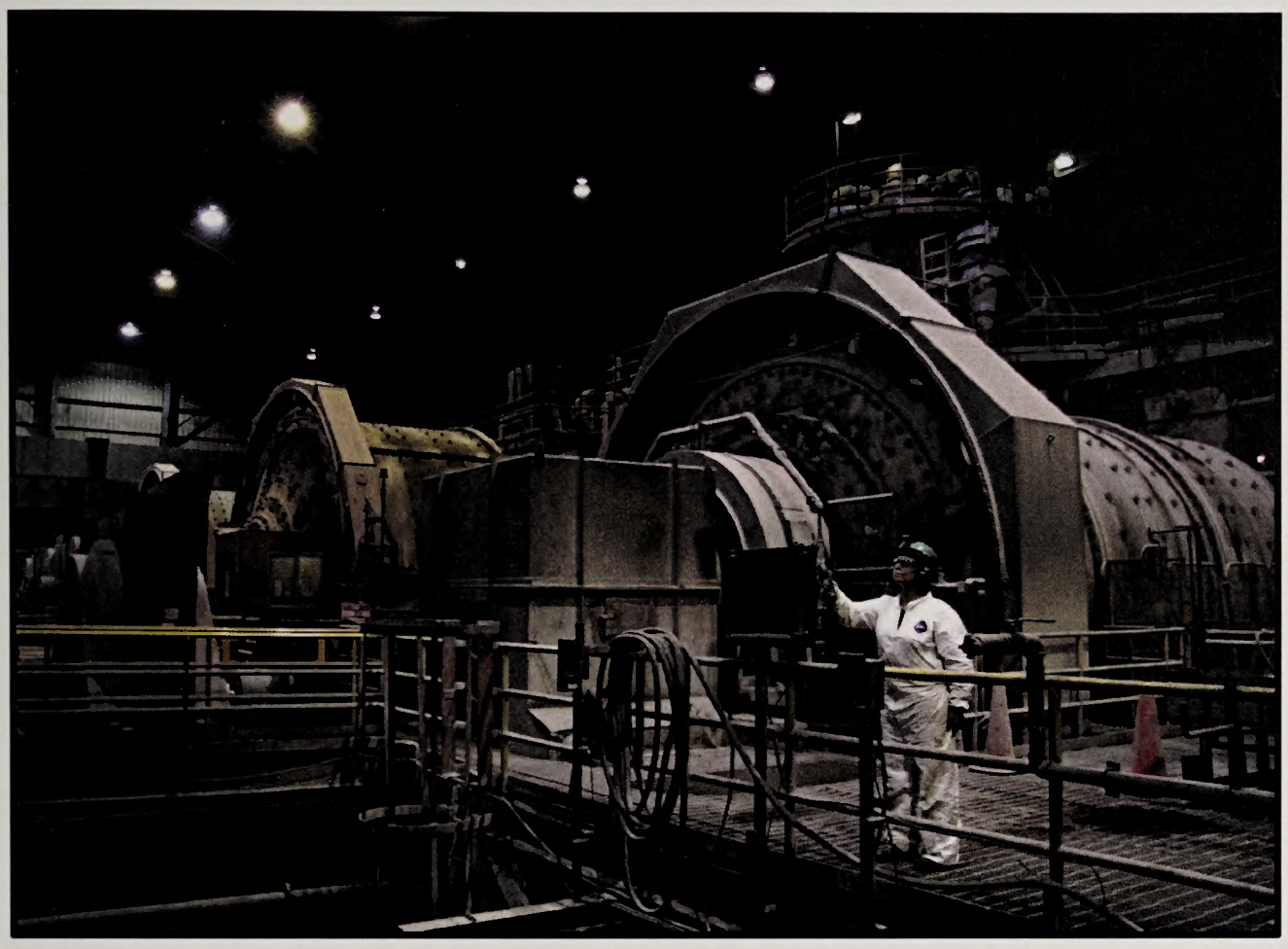


Photo 2.1-9. Two SAG mills (photo left) and one ball mill (photo right).



Photo 2.1-10. Column flotation cells.



Photo 2.1-11. Bluish molybdenum concentrate (not toxic).

After the molybdenite has been removed from the ore, the remaining ground rock slurry (tailings) is processed during the non-freezing months to remove most of the pyrite (potentially acid-generating) from the tailings. The tailings then flow through an above-ground pipeline to the TSF, approximately 7,000 feet to the north in the Bruno Creek drainage (Figure 2.1-1., Photo 2.1-12., Photo 2.1-13., Photo 2.1-14.), where the pyrite is piped separately and disposed of in a specific area of the TSF impoundment. In this specific area the pyrite remains under water and cannot oxidize.

The TSF embankment (dam) is constructed above a rock toe dam. The pyrite-reduced tailings pass through cyclone separators along the crest of the embankment where the coarse (sand size) material is separated from the fine ("slime") material and used in the continuing upward construction of the embankment. The fine tailings slurry from the cyclone separators is piped into the impoundment area behind the embankment where the solids settle out from the water forming a beach of settled solids near the embankment with a free water pond in the impoundment outward from the beach.

The embankment is raised each non-freezing season using coarse tailings to a height necessary to safely contain behind the embankment the pyrite concentrate and the fine tailings slurry during the non-freezing season, as well as the volume of whole tailings (coarse + fine + pyrite) placed behind the embankment during the freezing months. During these months no cycloning or raising of the embankment occurs to avoid snow and ice entrapment in the embankment. Also, no pyrite separation occurs as the whole tailings are deposited approximately 600 feet upstream

of the embankment, i.e., not exposed on the embankment or beach where the pyrite may readily oxidize.



Photo 2.1-12. TSF embankment.
Header pipeline, cyclones and embankment face, view to northeast.



Photo 2.1-13. TSF impoundment, view to north up Bruno drainage (filled).
Beach in foreground, tailings slimes pipelines at right.



Photo 2.1-14. TSF embankment face, view to northeast.

All water that contacts the impoundment (i.e., from the tailings slurry, precipitation or surface run-off) is captured at either the surface or toe of the impoundment and reused in the mill for grinding and flotation. Most of this water derives from the tailings slurry that separates from the solids to the surface of the impoundment. Most of the surface run-off intercepted by the impoundment is the flow from Bruno Creek upstream of the impoundment, except during the spring run-off when the flow is diverted into a pipeline that bypasses the impoundment and restores the water to the Bruno Creek channel downstream of the impoundment. At the end of Phase 6 the impoundment contained approximately 200 million tons of tailings, and the top of the embankment was 7,600 feet.

2.1.1.6. Water Management

Water management facilities include sedimentation ponds downstream of mine waste facilities in the Pat Hughes, Buckskin, and Bruno Creek drainages; contact water seepage collection systems below the Pat Hughes and Buckskin WRSFs; various surface water run-off diversion and collection systems; permitted outfalls, pit dewatering facilities; the SRD and impoundment; the pump-back system; a process water treatment plant (PWTP); freshwater, firewater and reclaim pump stations; and associated electrical power lines (Section 3.4). Groundwater cutoff walls, planned for the end of Phase 7, were constructed during Fall 2014. Note that TCMC has State

water rights for all of the water used by the mine, including the water intercepted by the open pit, and that there would be no differences in these water rights under any of the MMPO alternatives.

All of the diversion ditches, the Mill Creek diversion/sediment interceptor pond, the Bruno Creek diversion berm, the two Bruno Creek sedimentation ponds, and the culverts (except the culvert that would be installed for the Phase 8 West Road) are designed to manage the 100 year/24 hour storm during mining. The culvert for the Phase 8 West Road would be designed to manage the 500 year/24 hour storm during mining. All of the other structures that intercept water are/would be designed to handle at least the 500 year/24 hour storm during mining, except the TSF which is designed to handle the probable maximum flood during both mining, reclamation, and post-reclamation.

All of the structures that would intercept water post-reclamation would be designed to manage at least the 500 year/24 hour storm, except diversion ditch culverts and the Buckskin slope diversion channel (between the south side of the Buckskin WRSF and the open pit) would be designed to manage the 100 year/24 hour storm. However, the Buckskin slope floodplain would manage the 500 year/24 hour storm, and the diversion ditches would manage the 500 year/24 storm even if the culverts washed out.

There are sedimentation ponds (Photo 2.1-15.) downgradient of each of the WRSFs and the TSF to intercept run-off water and materials eroded from the faces of the WRSFs and the embankment (the sedimentation pond at the toe of the tailings embankment is termed the SRD). The sedimentation ponds are monitored and maintained to ensure that adequate storage capacity is maintained. Water may be discharged from the sedimentation ponds and related pipeline systems to five permitted NPDES discharge points (outfalls) in local drainages (Figure 2.1-2.); however, only Outfalls 001, 002, and 003 are currently used.

Drainage from the Buckskin WRSF is captured in an unlined sedimentation pond at the toe of the facility and either discharged to Thompson Creek at Outfall 001, or routed (gravity flow) via the Thompson Creek pipeline to the Cherry Creek storage tank/pump station, where the water is pumped to the mill for use as process water. Water from two natural springs near the mouth of Buckskin Creek is also diverted to the Thompson Creek pipeline for use at the mine. Water from the upper Pat Hughes drainage (above the main administration/crusher area) is collected before it comes into contact with waste rock. This water is pumped via the Pat Hughes diversion pump station around the WRSF to the Pat Hughes unlined sedimentation pond and either discharged at Outfall 002, or routed (gravity flow) to the Thompson Creek pipeline and to the Cherry Creek storage tank/pump station for use as mill process water. Run-off water from the main administration/crusher area is collected in an underground storm sewer with various collection points and settling ponds (that does not intercept any process effluent or sanitary sewage), and is also pumped to the Pat Hughes sedimentation pond. Run-off at the mill site is collected in a storm sewer system (which does not intercept any process effluent or sanitary sewage) that discharges to the TSF impoundment via an emergency overflow ditch.

Run-off from the mine access roads and intermittent flows from upper Bruno Creek (diverted in a pipeline around the TSF impoundment) are discharged at Outfall 003 on Bruno Creek near its confluence with S. Creek. Outfall 003 has no permitted effluent limitations, but must comply

with all applicable water quality laws, BMPs, and certain monitoring requirements. Sediment generated by run-off from the Bruno Creek access road is controlled primarily by a series of silt-protected road windows, filter barriers, and two engineered sedimentation ponds in the lower Bruno Creek drainage prior to discharge at Outfall 003.

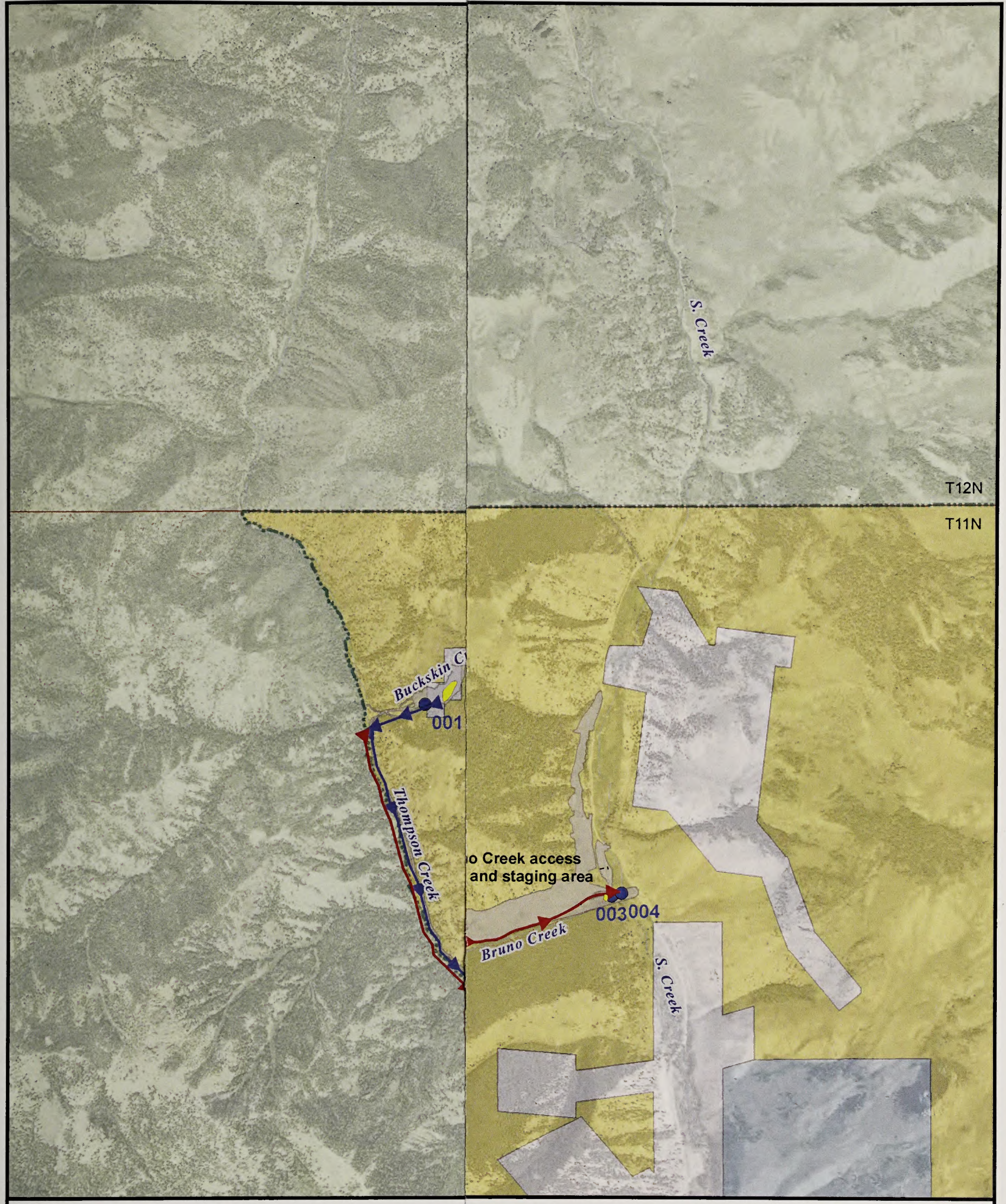
Perennial flow from Twin Apex Creek enters the Bruno Creek channel downgradient from the TSF pump-back station. Bruno Creek is a gaining stream (i.e., gains water from groundwater) from that location to Outfall 003. Two sedimentation ponds with decant structures are maintained on lower Bruno Creek.

Outfall 004 is on S. Creek just upstream of the mouth of Bruno Creek. The outfall may be used to discharge water collected by the pump-back system and transmitted (gravity flow) through the Bruno Creek pipeline. However, the water in the SRD is currently pumped back to the mill and reused. There is also a lined sump and pump-back system downgradient of the SRD in case any water should escape from the SRD. Any water intercepted by the sump would be pumped back to the SRD. The inlet of the Bruno Creek pipeline is at the pump-back station below the SRD. TCMC has never discharged at Outfall 004.

Outfall 005 is on the Salmon River 200 feet upstream of the mouth of Thompson Creek. Outfall 005 may be used to discharge water from the open pit, the northeast abutment of the TSF, and the pump-back sump/station. TCMC has never discharged at Outfall 005.

The open pit intercepts groundwater, run-off water from adjacent areas, and precipitation into the pit. The pit dewatering system consists of several collection sumps at the bottom of the pit and dewatering wells. Water is pumped from the sumps and wells to the pit dewatering pump station, where the water is pumped to the pit dewatering booster station. The booster station pumps the water to the PWTP for use as fresh water in the milling process.

Approximately 2,500 gallons per minute (gpm) of water is used at the mine for dust control, drill water, fire protection, drinking water, etc. The PWTP was constructed in 2009 and treats water from the Buckskin and Pat Hughes WRSFs, springs along Buckskin Creek, and water from the open pit for use as process water in the mill. The mill uses approximately 7,200 gpm of which 4,500 gpm is recycled from the TSF pond, 1,000 gpm is recycled from the SRD, and 1,700 gpm is treated water from the PWTP. Approximately 80 gpm is withdrawn from two wells for potable water use only (~ 40 gpm from each well). One of the wells is near the crusher and the other well is next to the mill. If the amount of water intercepted by the mine and routed to the PWTP is insufficient, fresh water can also be pumped to the PWTP from the Salmon River in a pipeline along Thompson Creek (Figure 2.1-2.). This water is withdrawn via an infiltration gallery (grid of perforated pipe) in the bed of the Salmon River 200 feet upstream of the Thompson Creek Bridge. The intercepted water is pumped to the mine via the Thompson Creek pipeline from a pump station next to the streambank.



Legend

- Existing mining disturbance
- Existing mine structures
- NPDES outfall
- Sediment ponds

Mine waste water

- Fresh water flow
- Runoff diversion water flow
- Recycle water flow
- Wastewater flow

Figure 2.1-2
Current TCMC wastewater management
Thompson Creek Mine EIS

with all applicable water quality laws, BMPs, and certain monitoring requirements. Sediment generated by run-off from the Bruno Creek access road is controlled primarily by a series of silt-protected road windows, filter barriers, and two engineered sedimentation ponds in the lower Bruno Creek drainage prior to discharge at Outfall 003.

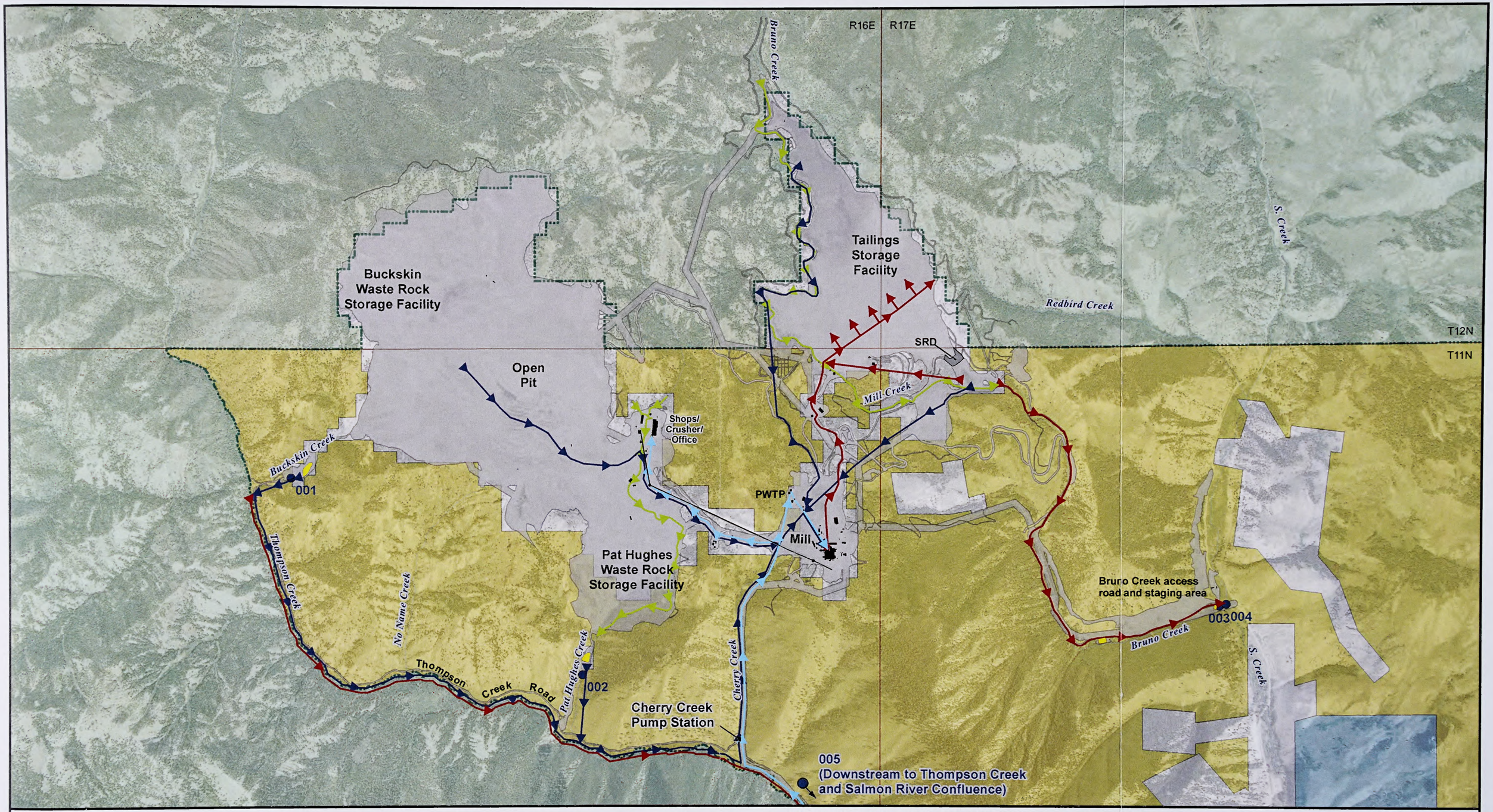
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Outfall 005 is on the Salmon River 200 feet upstream of the mouth of Thompson Creek. Outfall 005 may be used to discharge water from the open pit, the northeast abutment of the TSF, and the pump-back sump/station. TCMC has never discharged at Outfall 005.

The open pit intercepts groundwater, run-off water from adjacent areas, and precipitation into the pit. The pit dewatering system consists of several collection sumps at the bottom of the pit and dewatering wells. Water is pumped from the sumps and wells to the pit dewatering pump station, where the water is pumped to the pit dewatering booster station. The booster station pumps the water to the PWTP for use as fresh water in the milling process.

Approximately 2,500 gallons per minute (gpm) of water is used at the mine for dust control, drill water, fire protection, drinking water, etc. The PWTP was constructed in 2009 and treats water from the Buckskin and Pat Hughes WRSFs, springs along Buckskin Creek, and water from the open pit for use as process water in the mill. The mill uses approximately 7,200 gpm of which 4,500 gpm is recycled from the TSF pond, 1,000 gpm is recycled from the SRD, and 1,700 gpm is treated water from the PWTP. Approximately 80 gpm is withdrawn from two wells for potable water use only (~ 40 gpm from each well). One of the wells is near the crusher and the other well is next to the mill. If the amount of water intercepted by the mine and routed to the PWTP is insufficient, fresh water can also be pumped to the PWTP from the Salmon River in a pipeline along Thompson Creek (Figure 2.1-2.). This water is withdrawn via an infiltration gallery (grid of perforated pipe) in the bed of the Salmon River 200 feet upstream of the Thompson Creek Bridge. The intercepted water is pumped to the mine via the Thompson Creek pipeline from a pump station next to the streambank.



Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Aerial image NAIP 2009
Coordinate system UTM Zone 11 NAD 83

Legend

- Existing mining disturbance
- Existing mine structures
- NPDES outfall
- Sediment ponds

Mine waste water

- Fresh water flow
- Runoff diversion water flow
- Recycle water flow
- Wastewater flow

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1 1:32,000 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.1-2
Current TCMC wastewater management
Thompson Creek Mine EIS

The PWTP uses hydrated lime to adjust the pH and then clarifiers and disc filters to remove suspended solids. Flocculants are chemicals used in the clarifiers to promote the clumping of particles to aid in the removal of solids. The solids or sludge from the clarifiers and disc filters are combined with the mill tailings for disposal in the TSF.

Systems of blanket and finger drains were constructed within and at the base of the TSF embankment to drain the embankment and maintain it in an unsaturated condition. Regardless, some water seeps into the soil and rock underlying the embankment. To control and monitor the quality of water at the site, two systems were constructed: 1) the SRD (sedimentation pond) to capture drain water, and 2) a network of wells to monitor ground water around the perimeter of the embankment. Water from the SRD is pumped back up to the top of the TSF or to the reclaim water storage tank for the mill.

Sewage generated at the mine site is treated using a conventional septic tank and drain field system south of the mine change house. Sewage from the mill is piped to a holding tank and then pumped by the sewage lift station to the tailings pipeline for disposal in the TSF.



Photo 2.1-15. Sedimentation pond (SRD) below the TSF embankment.
View to southeast.

2.1.1.7. Environmental Controls and Monitoring

Operational (i.e., non-reclamation) environmental controls and monitoring activities at the mine include the following:

- Fugitive dust suppression and point source emission controls;
- Erosion, run-off, and sedimentation controls according to BMPs with discharge of collected water through permitted NPDES outfalls;
- Prevention and control of petroleum and chemical spills;
- Waste rock monitoring, classification, and management;
- Selective management of pyrite in the tailings and potentially acid-generating (Type 2) waste rock;
- Monitoring and reporting for multiple environmental media according to approved plans;
- Compliance with a road maintenance and transportation plan to protect surface water quality; and
- Stability monitoring of the TSF, pit highwalls, and WRSFs.

TCMC follows environmental compliance plans for each of these areas of environmental concern as part of the current MPO. The MPO also provides additional environmental protection measures. The TCMC consolidated environmental monitoring program for 2007 to 2012 (TCMC 2008a) is a part of the MPO that describes the annual environmental monitoring program related to biological conditions, air emissions, NPDES permit compliance, structural stability and dam safety, mine waste monitoring, and water quality monitoring. These plans and additional environmental protection measures, which would apply to all MMPO alternatives, are summarized below by resource.

Geologic Resources and Geotechnical Issues

A review of geologic formations and known paleontological resources was conducted. Paleontological resources would be avoided until the Forest Service, BLM, or an agency-approved paleontologist conducts investigations as needed to determine the significance of the fossils. At the discretion of the BLM or Forest Service, these fossils would be avoided for a length of time that is reasonable (e.g., 45 days after notification to the authorized officer of such discovery) to allow agency personnel to conduct the investigations. TCMC would be responsible for the cost of these investigations, evaluations, and mitigations.

Soil Resources

Only the minimum areas necessary for mining would be disturbed. Under the MMPO action alternatives, soil growth medium (e.g., topsoil) would be salvaged from proposed disturbed areas where topography allows (i.e., not on slopes of the WRSFs and the TSF that are too steep for heavy equipment to operate) for use in reclamation. Approximately 8.5 acres of topsoil and

alluvial material would be salvaged from the area of the Pat Hughes WRSF expansion (Alternative M2) and approximately 4 acres from the No Name WRSF (Alternative M3) for construction of the under drains for these facilities.

Salvaged growth medium would either be transported to areas being reclaimed or stockpiled. Stockpiles would be protected from erosion by establishing a vegetation cover and using erosion control structures, as required (Photo 2.1-16). The stockpiles would be built and maintained with as little compaction as feasible. Growth medium would be applied during reclamation with minimal compaction and protected from erosion through revegetation, run-on controls, mulch, swales, terraces, silt fences, and other erosion control measures.

Vegetation, Forest Resources, and Invasive and Non-native Plants

Under the action alternatives, only the minimum amount necessary of vegetation and timber would be removed. TCMC would use any timber at the mine site (covered by mining claims) necessary for its operations without payment to the BLM or Forest Service pursuant to Federal mining laws (TCMC has not had such use to date and does not foresee such use). All other timber would be disposed of by the BLM or Forest Service, with TCMC reasonably accommodating the agencies and/or their permittees in disposing of the timber. In many cases, to expedite timber removal, TCMC would voluntarily cut and deck the timber at its own expense to agency specifications. Non-merchantable timber, brush, and slash would be stockpiled for use as run-off and sediment control brush barriers along the downhill margins of disturbed areas. Small brush and slash would be incorporated in the topsoil when it is salvaged. Invasion of noxious weeds is minimized through monitoring and controlling noxious weeds under the TCMC weed control program. This program has been effective and adheres to Federal, State, and county regulations related to the application and use of selected herbicides. Records are kept related to completed reclamation work, weed control, and maintenance on disturbed sites.

Wildlife, Fish, and Aquatic Resources

Drivers would be required to report all collisions on the mine property involving wildlife (and people or property), and these incidents would be reported to the appropriate agencies. If appropriate, mitigation measures would be developed for areas with high collision rates to reduce the collision frequency, effects to wildlife and vehicle damage (to date there have been no such collisions). The mine operations would inherently accommodate wildlife movement (including migration) by virtue of the many areas of undisturbed habitat and reclaimed areas at the mine that provide migration routes around mine features such as the pit, faces of the WRSFs, or the TSF. The haul roads would not be barriers to wildlife movement due to the relatively low traffic and slow speeds (e.g., 35 mph maximum).

Aquatic habitat monitoring is conducted in accordance with the consolidated environmental monitoring program (TCMC 2008a). There are two periphyton and macroinvertebrate sample sites each on Thompson Creek, S. Creek, and on the Salmon River that are monitored annually. Fish are surveyed annually in Thompson Creek and S. Creek. Four sediment sampling stations are monitored annually to evaluate channel substrate, compare the composition of fine sediment upstream and downstream of the mine, and determine the amount of metals-loading in sediment downstream of the mine. One station upstream of the mine and one downstream of the mine are located on Thompson Creek and S. Creek.

Water Resources

Water quantity and quality environmental controls and monitoring are detailed in the consolidated environmental monitoring program (TCMC 2008a). Flow volumes are measured throughout the Thompson Creek drainage, including at monitoring sites on streams, at diversions, and below sedimentation ponds. Water quality monitoring is described in the water quality monitoring plan in TCMC (2008a). Water quality samples are collected at 43 surface water and 27 groundwater sites. The monitoring schedule includes daily, weekly, monthly, quarterly, semi-annual, and annual sampling events, each with their own set of parameters. Monitoring frequency of certain parameters is determined seasonally (according to stream flow conditions), with additional monitoring during spring run-off. Required monitoring includes water chemistry, water discharge flow rates, dilution ratio, effluent toxicity, sediment loading, and several field parameters such as pH, specific conductance, and temperature. Water monitoring for NPDES permit compliance also includes measuring the water quality of receiving streams at points above and below the NPDES discharge points. TCMC has also developed other operational plans to protect the quality of surface water and groundwater in perpetuity, including the following:

- Water management plan (Lorax 2012a) – includes long-term capture and treatment of drainage from the WRSFs and the TSF, along with management of the final pit lake level through pumping and treatment prior to discharge through the existing permitted NPDES discharge points (the plan was developed as part of the NEPA process for the project and is now considered part of the MMPO, and is described as part of Alternative M1 even though the plan has not been approved by the agencies);
- Adaptive groundwater management plan (Lorax 2012b) – provides the framework to establish or augment baseline characterization of groundwater flow and quality; the methodology for identifying mitigation performance; and the approach for identifying, designing, and implementing site-specific mitigation to meet water quality standards (WQSs) and site-specific performance metrics;
- Spill prevention, control, and countermeasures (SPCC) plan (ARCADIS 2010) - developed to prevent spills of petroleum products and to minimize the risk of injury to employees and minimize damage to the environment in the event that a spill should occur; and
- BMP plan (TCMC 2010a) - designed to prevent or minimize the generation and the potential for the release of pollutants from the mine site to surface water and groundwater through normal and ancillary activities.

Wetlands, Floodplains, and Riparian Areas

Only the minimum areas necessary for mining would be disturbed. Boundaries and characteristics of all WUS (including wetlands and riparian areas) in the disturbance footprints of the MMPO alternatives have been delineated and described (Section 3.9). Run-off from planned disturbance upgradient of wetlands and riparian areas would be controlled to reduce transport of sediment and contaminants into the wetlands and riparian areas.

Air Quality

Fugitive dust would be managed according to the fugitive dust control plan (TCMC 2008b). Fugitive dust from traffic on unpaved haul and access roads would be controlled primarily by water sprayed by water trucks and speed limits. Dust suppressing chemicals such as magnesium chloride and calcium chloride would also be used on roads as needed. A wind fence has been constructed around the coarse ore stockpile and would reduce fugitive dust from the pile by approximately 90 percent.

Cultural Resources

The proposed disturbance areas for the MMPO alternatives were inventoried for cultural resources during recent baseline surveys. If unanticipated cultural materials, historic sites, or human remains are encountered during mining, TCMC would immediately notify the Forest Service or BLM authorized officer, and operations would be halted in the vicinity of the discovery until inspected by BLM, Forest Service, or an agency-approved archaeologist, and a mitigation plan developed, if necessary. Cultural resources would be avoided until the Forest Service, BLM, or an agency-approved archaeologist conducts investigations as needed to determine the significance of the finding. At the discretion of the BLM or Forest Service, these cultural resources would be avoided for a reasonable length of time (e.g., 45 days after notification to the authorized officer of such discovery) to allow the agency personnel to evaluate and determine the significance of the find.

Overburden Cover

The classification (Type 1 or Type 2) and handling of the overburden is described in Section 2.1.1.3.

Management of Hazardous Materials and Petroleum Products

Management of hazardous materials, hazardous wastes, and petroleum products would be performed in compliance with applicable Federal and State requirements. Approximately 55 gallons per year of hazardous waste (e.g., acetone) and petroleum waste (crushed oil filters and grease) would be removed from the mine by a contractor. Used oil is recycled off-site.

Inspections, Records, and Monitoring

During operations, daily inspections would be made by mine supervisory staff of all active operations to ensure compliance with conditions of approvals, applicable permits, and regulations. Records of these observations would be kept on-site in TCMC environmental records.



Photo 2.1-16. Salvaged topsoil storage pile.
Effective sedimentation and erosion control structures, lower Pat Hughes drainage, view to south.

Regular inspections for the stormwater pollution prevention plan (SWPPP) and SPCC plan would be conducted to document compliance with these plans and detect any conditions requiring modification to maintain compliance. All maintenance, repair, or modifications related to the SWPPP and SPCC plans would be documented in TCMC on-site environmental records.

TCMC would continue to ensure that chemical analyses of sample of storm water, groundwater, soil, sediment, aquatic biota, vegetation, and surface water would be made as required by the consolidated environmental monitoring program (TCMC 2008a).

The mine would continue to be inspected by a variety of Federal and State agencies such as the EPA, Mine Safety and Health Administration (MSHA), BLM, Forest Service, IDWR, IDEQ, IDL, etc. The BLM and Forest Service typically inspect the mine several times per year to determine compliance with the approved MPO. In addition, the mine is regularly inspected by an interagency taskforce (defined by a Memorandum of Understanding [MOU]) composed of the BLM, Forest Service, IDWR, IDEQ, IDL, and Idaho Department of Fish and Game (IDFG).

2.1.1.8. Reclamation

TCMC has reclaimed approximately 660 acres as of June 2011 (Figure 2.1-3., Photo 2.1-17., Photo 2.1-18). Concurrent reclamation activities during the last 30 years at the mine have been primarily removing non-native materials, recontouring, revegetation, and aesthetic measures such as boulder scattering. The primary goals of these efforts are to provide slope stability, and to return disturbed areas to a relatively natural function (e.g., vegetation to minimize soil erosion and maximize wildlife habitat) and appearance (e.g., would not be noticed by a casual observer). During the last 30 years, there has not been any slope failure of reclaimed areas and no additional recontouring has been necessary (Wall 2012). The overall result of the reclamation is such that a casual observer would not notice the site was once distinctly disturbed.

The 1979 reclamation plan (analyzed in the 1980 EIS) was revised and described in more detail in the 1999 consolidated reclamation plan, as amended (EnviroNet 1999) (analyzed in the 1999 EIS). Further information specific to reclamation water management for the MMPO is in the water management plan (Lorax 2012a). The consolidated reclamation plan is summarized below.



Photo 2.1-17. Reclaimed area of the Buckskin WRSF.
Steep section (photo foreground) and moderately steep section (photo background). View to south.



Photo 2.1-18. Reclaimed section of the Buckskin WRSF.
Reclaimed area is the slope in photo center. View to southeast.

Post-Mining Land Use Objectives

The overall goal of the reclamation plan is to reclaim the mine site to support wildlife habitats similar to those which occur adjacent to the site. Related objectives include hydrologic function, soil productivity, and aesthetics. The adjacent lands include steep to rolling slopes, rock outcrops, and gentle to flat open areas. The reclamation of the site would produce landforms which provide habitat features and increase the amount of habitat edge. The open pit would not be backfilled, but instead would be fenced and remain as a water storage facility.

The majority of the mine site and adjacent areas is transitional between sagebrush grassland and conifer forest, and reclamation of these areas would meet the objective of sagebrush (*Artemisia* spp.) and grasslands/conifer habitat. Landform features in this reclamation objective include generally flat to moderately sloping areas revegetated with a mix of grasses, forbs, shrubs, and coniferous trees. Portions of the site and adjacent areas provide elk and deer summer and winter range. Reclamation objectives for elk and deer habitat would also provide suitable habitat for small mammals, upland game birds and songbirds, raptors, mammalian predators, and reptiles.

Within and adjacent to the mine site there are disturbed areas of nearly barren rock on steep slopes, cliffs, and rocky outcrops (slopes of the open pit and WRSFs). Reclamation of these facilities would meet the objective of rocky slope habitat (provide terrestrial wildlife habitat).

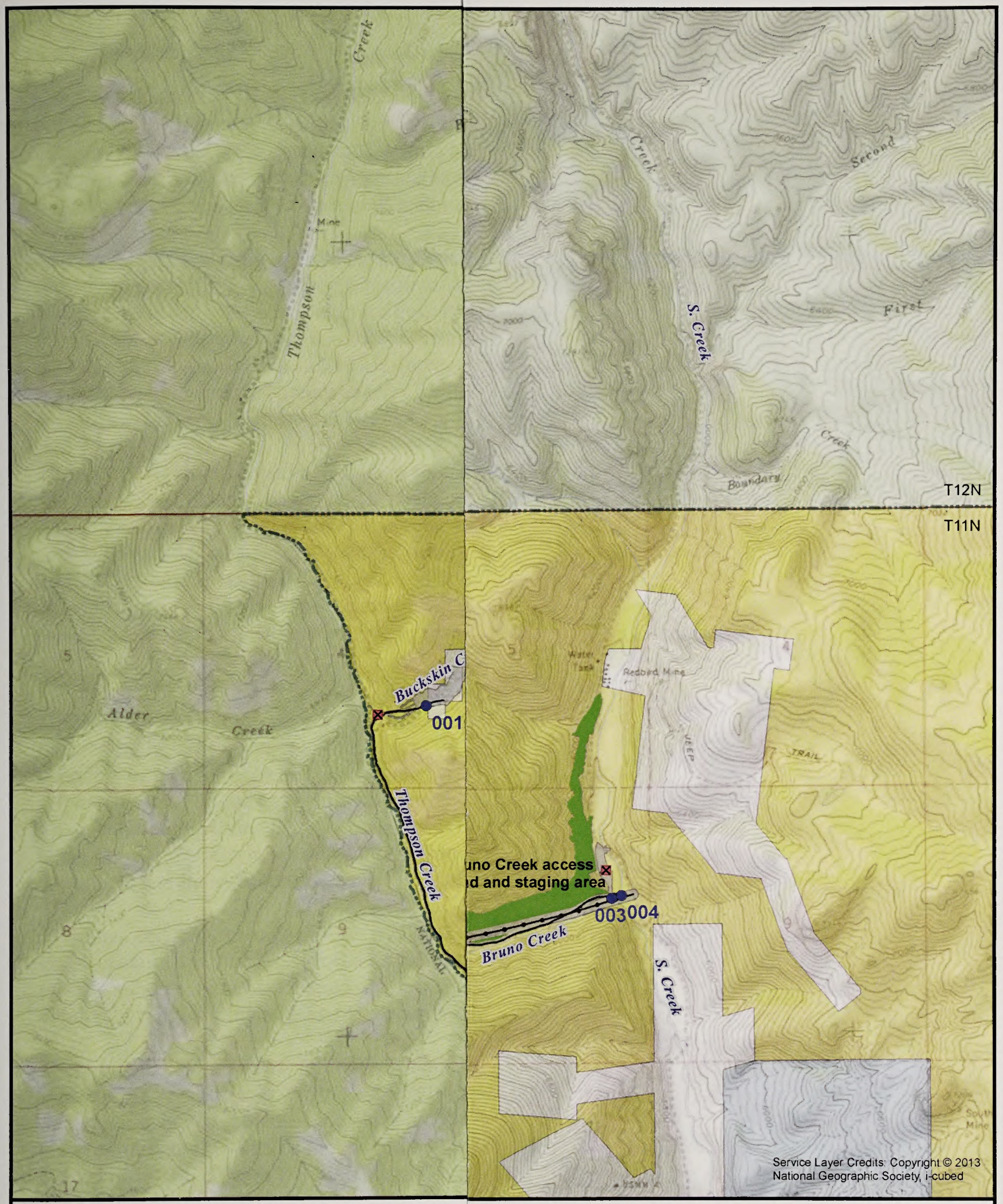


Figure 2.1-3
Current reclaimed areas, June 2011
Thompson Creek Mine EIS



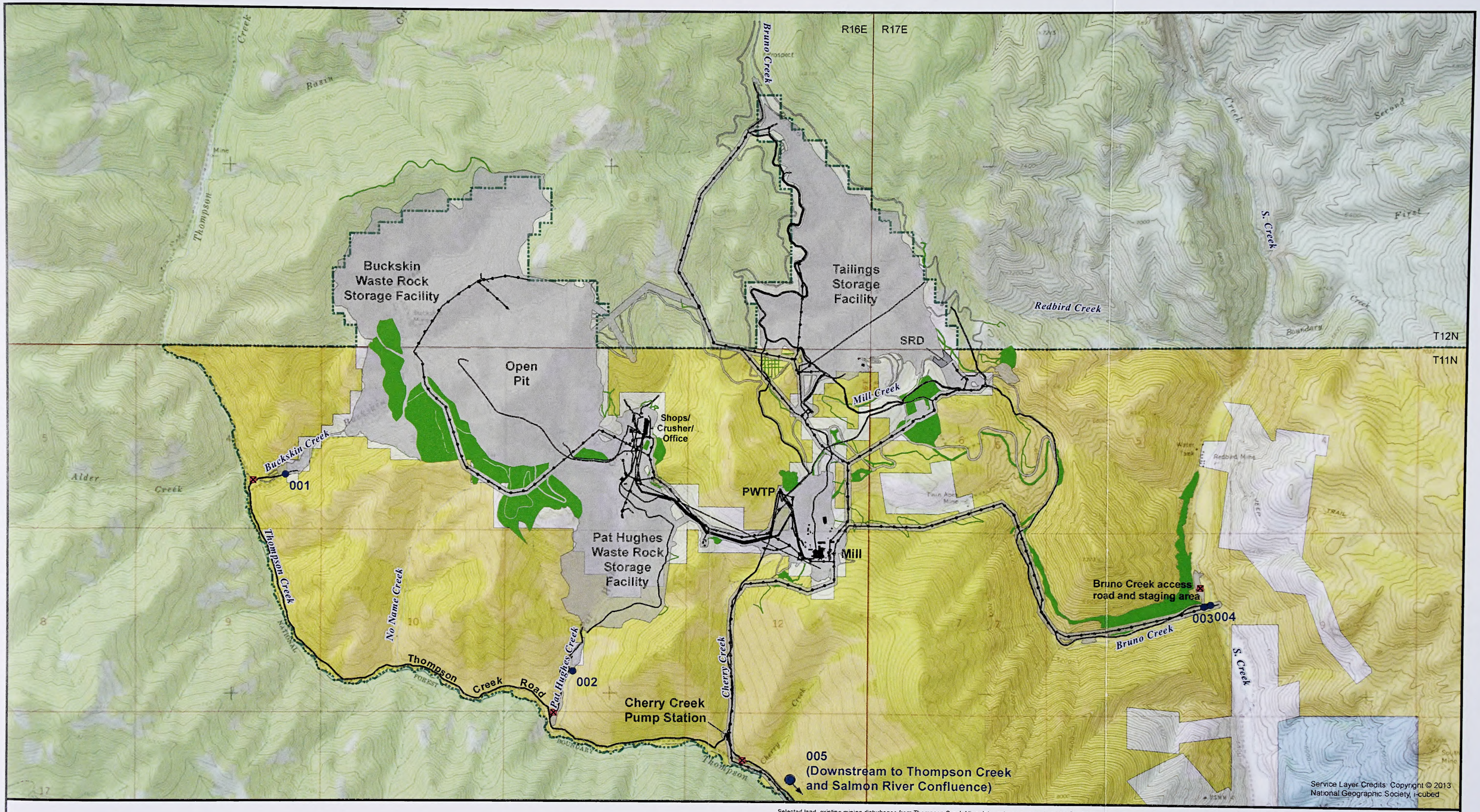
Photo 2.1-18. Reclaimed section of the Buckskin WRSF.
Reclaimed area is the slope in photo center. View to southeast.

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Within and adjacent to the mine site there are disturbed areas of nearly barren rock on steep slopes, cliffs, and rocky outcrops (slopes of the open pit and WRSFs). Reclamation of these facilities would meet the objective of rocky slope habitat (provide terrestrial wildlife habitat).



Legend

- Existing mining disturbance
- Reclaimed areas
- NPDES outfall
- Gate
- Existing mine structures
- Existing power line
- Existing pipelines

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintened by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.1-3
Current reclaimed areas, June 2011
Thompson Creek Mine EIS

Landform features in this reclamation objective include moderate to steep rock or talus slopes revegetated with grasses, legumes, and low shrubs to minimize hiding cover for predators with varying boulder sizes for escape and nesting habitat. The target species for this reclamation objective are the bushy-tailed woodrat and the yellow-bellied marmot. Reclamation features for these species would attract other small mammals and predators.

Blue spruce (*Picea pungens*) and aspen (*Populus tremuloides*) occur in and around the mine site in moist areas. Willows (*Salix* spp.), cottonwoods (*Populus* spp.), alder (*Alnus* spp.), sagebrush, and grasses occur in riparian communities. Reclamation of these areas would meet the objective of wetlands/meadow habitat. Landform features in this reclamation objective include flat to moderate sloping areas, pits, and ponds revegetated with a mix of upland and shoreline species for forage and cover. The target species for this reclamation objective include waterbirds, passerines, beavers, small mammals, and predators.

The special riparian habitat reclamation objective addresses the portions of the lower Buckskin, Pat Hughes, and Bruno drainages within the mine site which drain to Thompson and S. creeks. These drainage areas are generally characterized by willow, cottonwood, alder, grasses, and emergent aquatic plant species. Target wildlife species for this reclamation objective are salmonids found in both of these creeks. The focus of the special riparian habitat reclamation objective is to provide potential rearing habitat for juvenile fish and habitat for adult fish, passerines, waterfowl, and predatory species.

Facility Decommissioning

Towards the end of mining, stocks of materials such as fuels, lubricants, and reagents would be reduced to those necessary to complete mining. Excess materials would be returned to the suppliers or sold for use elsewhere whenever possible. Final stocks of chemicals that cannot be returned or used elsewhere would be properly packaged and disposed of off-site in permitted waste handling facilities. Tanks, pipes, pumps, vessels, sumps and other equipment or facilities using process chemicals would be cleaned and the residues disposed of in accordance with applicable regulatory requirements.

Buildings and structures (including power lines) not required for reclamation and maintenance of water management facilities would be dismantled and sold or demolished and the structural materials either sold or buried on-site in permitted, solid waste landfills. However, the administration building at the upper security gate would remain as a permanent site feature.

There would be one or two solid waste landfills at the mine site used for disposal of concrete, wood, piping material, etc. The landfill(s) would depend on the configuration of the WRSFs at reclamation, but the potential locations are the 7,250 foot bench of the Pat Hughes WRSF due to the proximity to the WRSFs that would require demolition, and the 7,600 foot bench of the Buckskin WRSF (Figure 2.1-1). TCMC has an industrial landfill permit for solid waste at the Buckskin WRSF.

All above-ground remaining materials, equipment, pipelines, culverts, and facilities would be removed to ground level and either sold as scrap or disposed of in the landfill(s). Subgrade facilities, including buried pipes, cable trays, sumps, sewers, etc. would be plugged at their

surface openings and decommissioned in place to minimize surface disturbance. Concrete foundations would be broken down to ground level and removed to the landfill(s) or buried in place and covered with earth to form natural-looking landforms. Backfill used to achieve final grades and landforms at the former facilities locations would consist of at least 3 feet of non-acid-generating (Type 1) rock covered by approximately 1 foot of growth medium.

Open Pit

Access to the edge of the open pit would be restricted by berms and/or rock piles and/or bar gates at the access roads leading to the pit. Warning signs approximately 2 square feet of weather resistant, reflective material would be placed around the perimeter of the pit every 200 feet for public safety. A fence would not be installed around the open pit. Areas accessible for seeding along the top of the pit would be seeded by hand broadcasting. The pit slopes would continue to produce rock falls to the interior of the pit. The rock fall would initially be retained on the remaining pit catch benches, but would ultimately obliterate some of the benches yielding talus slope-like features. Water (groundwater and surface run-off) would naturally accumulate in the bottom of the open pit forming a lake. During reclamation of the TSF, the tailings water removed from the impoundment area would be piped to the open pit for disposal. During and after reclamation of the WRSFs, water from these facilities would also be piped to the open pit, after being treated with lime. These water flows to the open pit are further described in the following Water Management section. Long-term weathering of the pit slopes would continue to occur above the water level. Maintenance of the pit lake is also discussed in the Water Management section below.

Waste Rock Storage Facilities

Under all of the MMPO alternatives the WRSFs would be reclaimed in a similar manner, except for the differences between Alternative M1 (Phase 7) and Alternative M2 and Alternative M3 (Phase 8) noted below. The reclaimed Buckskin facility would have three levels (benches) including the upper (8,100 to 7,900 feet); middle (7,900 to 7,630 feet); and lower (7,630 to 6,700 feet) (Phase 7 elevations – the Phase 8 elevations of the upper and middle benches would be somewhat higher). Although the 1999 MPO describes Type 2 waste rock at the surface and cells of Type 2 rock near the surface of the Buckskin WRSF, at the end of Phase 7 or Phase 8 all of the surface of the facility would be Type 1 rock (except for the lower bench slope) with no Type 2 cells within 150 feet of the margins or surface of the WRSF. The surface of the facility (benches and slopes, except the lower bench slope) would be graded to final contours to blend with surrounding topography and to divert run-off towards surface water diversion and collection ditches at the margins of the facility.

For Phase 7 the non-durable portions of the slopes of the upper and middle benches of the Buckskin WRSF would be graded to 2.5H:1V and the other portions would be left at the angle of repose (~ 1.5H:1V). For Phase 8 all of the slope between the upper and middle benches would be graded to 2.5H:1V, and the slope below the middle bench (which drains directly to the open pit) and the slope below the lower bench would be left at the angle of repose (Section 2.1.3.6). For Phase 7 all of the surface except the lower bench slope would be capped with 3 feet of volcanic Type 1 growth material, fertilized, and revegetated according to the revegetation plan.

The growth medium would support the establishment of vegetation to stabilize the final surface and to provide evapotranspiration of precipitation thereby reducing the moisture available to infiltrate through the cover. Phase 8 portions of the top of the upper bench would be capped with 1 foot of Type 1 growth material (primarily volcanic waste rock mixed with stockpiled soil), scarified, fertilized, and revegetated (because all surfaces would be Type 1 waste rock). The remaining surface of the facility would be scarified, fertilized, and revegetated, except the slope below the middle bench would be capped with 3 feet of durable non-volcanic Type 1 rock (Doughty 2013). The lower bench slope was established in the late 1980s prior to classification of waste rock; therefore, this portion of the facility likely has a mixture of Type 1 and Type 2 waste rock and would remain in its current configuration due to its steepness, durable rock cover, and demonstrated stability.

The reclaimed Pat Hughes facility would have three benches: 7,250 to 7,000 feet, 7,000 to 6,750 feet, and 6,750 to 6,400 feet (Phase 7 elevations – the Phase 8 elevations would be somewhat higher and there would be four benches). The slope below each of these elevations would be left at the angle of repose (Phase 7) or graded to 3H:1V (Phase 8) and covered with durable Type 1 waste rock. The surface of the facility would be graded to final contours to blend with surrounding topography and to promote run-off to a surface water diversion and collection ditches at the margins of the facility. The surface would be covered with 1.5 feet of compacted volcanic material, 5 feet of Type 1 volcanic rock, capped with 1 foot of growth media, scarified as required, fertilized, and seeded according to the revegetation plan. The last 800 horizontal feet to the toe of the WRSF would be covered with coarse, durable, non-volcanic, Type 1 material. The compacted volcanic material would produce a low permeability layer that would reduce infiltration into the underlying waste rock. The overlying uncompacted volcanic waste rock layer would be a thermal barrier protecting the compacted layer from freeze/thaw and would also serve as a moisture storage layer to reduce infiltration and support the growth of vegetation.

The No Name WRSF (under Alternative M3 only [Section 2.1.4.]) would have up to six benches. The WRSF would be reclaimed as described for the other two WRSFs, except that areas of the WRSF with Type 1 waste rock at the surface would be covered with 1 foot of growth media, scarified as required, fertilized, seeded, and areas of the facility with Type 2 waste rock at the surface would be covered with 1.5 feet of compacted volcanic material, 5 feet of Type 1 waste rock, capped with 1 foot of growth media, scarified as required, fertilized and seeded according to the revegetation plan.

TSF

The design plans for the reclamation of the TSF are in the original tailings closure plan (SRK 1982). The plans were updated and are summarized in the consolidated reclamation plan (EnviroNet 1999), and the plans were updated again in 2008 (WMC 2008). However, the reclamation of the TSF is the authority of the IDWR and IDL, and the IDWR does not approve reclamation design plans for TSFs until the time of final reclamation (but the IDWR must approve any change to the operating plan for a TSF before the change is implemented). Therefore, the most probable reclamation of the TSF is described in this section, e.g., as a slightly steeper embankment face has been approved for during mining, the reclaimed face would necessarily have the same steeper slope (WMC 2008).

The final elevation of the TSF embankment (dam), without the reclamation cap, would be 7,646 feet under Phase 7 (7,742 feet under Phase 8) with a downstream slope of 2.75H:1V. The lowest elevation of the original ground surface below the crest of the embankment is 6,980 feet. Including 10 feet of reclamation cover, the height of the embankment would be 676 feet (Phase 7) or 772 feet (Phase 8). Near the end of ore milling, the surface of the tailings solids in the impoundment would slope downward (~ 0.5 %) to the northwest from the embankment to the upstream end of the impoundment where the tailings water collects in a pond. However, prior to final mill shutdown, the surface of the tailings solids in the impoundment would be recontoured to reverse the slope to approximately 1 percent toward the embankment. This would be accomplished by ceasing the centerline construction along the embankment and instead discharging whole tailings in a pipeline to the upstream end of the impoundment. The resulting tailings water pond would be relocated from the far end of the impoundment area to the southwest corner of the impoundment. Additional recontouring of the surface of the impoundment would be minimal.

During the final 2 years of mining and during the recontouring of the surface of the impoundment, the impoundment area would be covered by a 7 foot thick layer of pyrite-reduced tailings solids. The current location in the impoundment where pyrite concentrate is disposed of (southwest corner) would eventually be covered. At that time (with mining complete or nearly complete), any residual amounts of pyrite concentrate would be disposed of in the bottom of the open pit. The impoundment area would then be covered (capped) with a 2 foot thick layer of inert material capable of supporting the growth of vegetation used for reclamation. This material would be Type 1 volcanic overburden that would be ground in the mill to form a slurry, and then delivered to the impoundment area using the TSF pipeline system. The downstream face of the embankment would be covered with inert, durable rock.

After the final grade is established for the surface of the impoundment, the water in the TSF pond would be removed from the impoundment and pumped to the open pit for disposal. The exposed tailings solids would be allowed to drain and consolidate to produce a dry surface that can support heavy equipment for reclamation. The channel for Bruno Creek would be re-established on the surface of the impoundment area and the existing Bruno Creek diversion structures and pipeline would be removed. The channel would be designed to allow for the average annual flow of Bruno Creek (10 cfs), with a minimum of 1 foot of freeboard and the maximum recorded flow for Bruno Creek (42 cfs) with 0.5 foot of freeboard. The average baseflow velocity of this channel would be approximately 3 to 4 feet per second. The channel design is further described in the Water Management section below.

The final surface of the impoundment would slope toward the southwest corner of the impoundment area. The final configuration of the embankment and impoundment area would have the capacity to store the 96 hour probable maximum flood waters from the upstream Bruno Creek watershed to a maximum stage elevation of 7,742 feet (Phase 8), conservatively assuming no outlet for surface flow from the impoundment, and leaving 10 feet of freeboard on the reclaimed embankment (WMC 2008). This design was checked with a scenario of a 100 year/24 hour rainfall event with 5.34 inches per day of snowmelt run-off (estimated maximum rain-on-snow run-off event) and found to contain the resulting run-off to a maximum stage elevation of 7,740 feet, leaving 12 feet of freeboard at the reclaimed embankment.

However, as described below in the Water Management section, the facility would be fitted with a spillway channel in the southwest corner of the impoundment so stormwater collected under either of these scenarios would actually be routed through the spillway during and after the flood event. The maximum depth of water stored behind the embankment would be less than calculated above, which also assumed no outlet.

The downstream slope (face) of the embankment would have benches every 100 feet in vertical elevation and slope towards the abutments to reduce the potential for run-off down the embankment face. The embankment face would be recontoured into the benches to maintain an overall slope of 2.75H:1V. Each bench would be sloped back to retain stormwater run-off from the bench. Three drainages (bench drainage, perimeter drainage, and tie in drainage) would be constructed along the embankment. The benches would be covered with 3 feet of inert, durable rock obtained from the TSF rock borrow areas (see below), 6 inches of growth medium, and revegetated. The embankment slopes between the benches would be covered with 3 feet of inert, durable rock from the TSF rock borrow areas.

The TSF seepage collection system would continue to function following reclamation, but at decreasing flow rates as no tailings slurry would be added to the impoundment and surface infiltration would be minimal due to the cap and surface water diversions (Bruno Creek). The SRD would remain in place and water collected in the SRD would ultimately be processed at the water treatment facility.

The reclaimed TSF would permit water to infiltrate through the surface, i.e., the natural development of trees on the surface of the TSF would not compromise the water balance for the facility. The surfaces of the benches on the TSF embankment would be covered with durable rock (riprap), which would not be materially affected by tree growth. There would be relatively slow growth of trees in the locality and relatively shallow tree root systems. Should large-diameter trees need to be removed for any unforeseen reason, such would be part of the long-term erosion maintenance of the TSF.

Two rock borrow areas are planned to provide the inert rock required to reclaim the facility. The first would be north of the southwest corner of the impoundment area, and the second (already used as a borrow pit) would be east of Bruno Creek downstream of the facility. Two growth medium borrow pits would also be excavated to provide the growth medium required for reclamation of the facility. The first would be west of the facility, and the second would be southwest of the embankment. Upon completion of reclamation, the four borrow pits would be reclaimed by scarifying and seeding with the final reclamation seed mixture.

Roads

Roads or road segments would be reclaimed as soon as they are no longer required for mining, reclamation activities (including long-term activities such as water management and maintenance, environmental monitoring, inspection of reclaimed areas), or general site access. The remaining roads would be substantially reduced in width (Table 2.1-1). Pioneer (2010a) provides a more detailed description of the road reclamation.

Approximately 25 miles (80 acres) of roads would be reclaimed across their full widths by scarifying, contouring to blend with (and shed water to) adjacent topography, spreading growth material along the road shoulders and cuts, and seeding the disturbed areas with the reclamation seed mixture to re-establish vegetation. Steep cut and fill slopes that could not be recontoured would be stabilized by terracing, rock placement, riprapping and/or revegetating with mulch to prevent erosion. Haul roads in proximity to or within the WRSFs would be incorporated (obliterated) within the WRSFs as the WRSFs are reclaimed.

Table 2.1-1. Principle road reclamation (miles).

Road	TCMC	BLM	Forest Service	Current Width (feet)	Reclaimed Width (feet)
Upper Buckskin access	3.1	0.0	0.0	40.0	14.0
Main access	2.3	3.9	0.0	40.0	14.0
Northeast access	0.2	2.1	0.9	24.0	12.0
Repeater and power line access	1.0	0.3	0.4	12.0	0.0
TSF access	2.1	1.2	5.4	20.0	12.0
Cherry Creek	0.4	1.5	0.0	20.0	12.0
TOTAL	**9.1**	**9.0**	**6.7**		

Revegetation Plan

Revegetation would be conducted to stabilize reclaimed surfaces with perennial vegetation communities and restored to a post-mining land use for multiple use management. Certified weed-free seed would be used. The successful revegetation would include the establishment of at least 70 percent of the ground cover found on adjacent reference areas for two full growing seasons after cessation of soil amendment or irrigation (IDAPA 20.03.02.140.11.b). The emphasis for the revegetation efforts in terrestrial areas would be development of vegetative cover that would mimic the vegetation in the surrounding area, stabilize ground surfaces, and establish wildlife habitat to meet the land use objectives of the overall reclamation plan.

When final grades are established on disturbed surfaces, growth medium would be placed, spread, and scarified to facilitate vegetation establishment. Samples of the growth medium would be analyzed for essential nutrients for plant growth, and mulch and fertilizer would be applied as appropriate. Seed would be applied with various methods depending on equipment accessibility and area configuration. Drill seeding is the preferred method and would be used on flat areas and areas with slopes that can be negotiated by the drill seeding equipment. In areas of steeper slopes, seed would be applied by broadcast methods.

Site preparation for seeding would occur in late spring, summer, and early fall when snow is not present at the site. Seeding would generally occur in the fall before snow cover but after daily

temperatures are sufficiently low so germination does not occur. Seed placed in the fall can take full advantage of the moist spring conditions for germination and establishment. However, some seeding might occur in the spring.

In the 1980s, reclamation specialists from the Forest Service developed a vegetation seed mixture based on drought tolerant species. The mix had been tested on other reclamation projects within central Idaho (e.g., Blackbird Mine) with positive growth rates. The results of these efforts identified appropriate seed mixtures and soil amendments such that revegetation at the mine is now nearly always successful on the first attempt. That is, there are no distinct areas of bare soil or erosion such as rills or gullies, and wildlife regularly forage on reclaimed areas of the mine.

The current seed mixture varies somewhat year-to-year depending on the availability of seed species. The agencies would approve changes to this seed mixture based on seed availability, past success rates, and cost. Over the last 30 years TCMC has determined that an optimal seed application rate is 40 pounds per acre for drill seeding and 60 pounds per acre for broadcast seeding, with fertilizer rates of 250 to 500 pounds per acre depending on soil conditions. These seed and fertilizer rates would be used for concurrent and final reclamation unless changes were necessary to achieve the desired vegetation cover. The seed mixes consist only of native species or potentially non-invasive/sterile quick cover crops.

After seeding has established groundcover, shrubs (sagebrush and bitterbrush [*Purshia tridentate*]) and trees (primarily lodgepole pine [*Pinus contorta*]) would be hand-planted in selected areas designated for sagebrush/grasslands/woodlands habitat. Shrub seedlings would be raised from seeds collected on-site and tree seedlings would be obtained from a high-altitude seed source. Trees would be hand-planted in selected microsites on north or east aspects in patches to provide thermal and escape cover for wildlife. An average of 60 shrubs and 60 trees per acre would be planted. If an area is not conducive to shrub or tree growth it would not be planted. More planting would be done in locations farther from natural seed sources, with the assumption that areas near trees would have more natural regeneration.

Special riparian habitats would be established at the water management facilities that are required to operate during and after[3] reclamation: the sedimentation ponds below the WRSFs, the lower Bruno Creek drainage, and the SRD below the TSF. The vegetation species in these habitats would be willows, cottonwoods, alder, and a variety of grasses and emergent aquatic species that would either be planted or naturally established.

Post-reclamation Water Management

It is implicit in the consolidated reclamation plan (part of the approved MPO for the mine through Phase 7) that no water would be discharged that would violate any Federal or State water quality laws, i.e., the water would be treated if necessary. Since then, as part of the NEPA process for the project, TCMC has developed more detailed plans for long-term water management (Lorax 2012a). These include long-term capture and treatment of drainage from the

[3] The facilities are described in the consolidated reclamation plan as being removed after Phase 7, but would be necessary as part of the water management plan for either Phase 7 or Phase 8.

WRSFs and the TSF, along with management of the final pit lake level through pumping and treatment prior to discharge through the existing permitted NPDES discharge points. The details of the water management plan are now considered part of the MMPO, and are considered part of Alternative M1 even though the water management plan has not been approved by the agencies (Section 2.1.2).

During any short-term halts to mining, water from the mine site would be treated at the PWTP and discharged to the pit (Figure 2.1-2). During any long-term halts to mining, water from the mine would be treated at the PWTP and discharged at Outfalls 002 or 005 (Figure 2.1-2.) or to the pit. The lower portion of the open pit would gradually fill with water to an elevation of 7,030 feet in an estimated 30 years for the Phase 7 pit and 70 years for the larger Phase 8 pit. The open pit would naturally collect surface run-off and groundwater. In addition to the natural water collected, the open pit would be used as a storage facility for the management of poor quality water collected at the WRSFs. This water would be piped from the WRSFs to a lime treatment plant prior to discharge to the pit to maintain neutral, moderate water quality within the open pit lake. The initial drainage water from the TSF would also be pumped to the pit lake. More details of these wastewater flows to the open pit are described below.

The water level in the open pit would rise to an elevation of approximately 7,030 feet where the level would be maintained through pumping as required to prevent the water from entering a historical adit (sealed) at approximately 7,040 feet. Water pumped from the pit would be treated either in a long-term water treatment facility or a modification of the existing PWTP to meet the NPDES limits for Outfall 005 (Salmon River). This treated water would be piped to Outfall 005.

The water management system includes run-off diversions, culverts, WRSF and TSF seepage collection facilities, sediment traps and run-off collection ponds, pump stations, pipelines, and associated electric power lines. These facilities would be decommissioned in phases as they were no longer needed during the reclamation program. The fate of the Buckskin and Pat Hughes sedimentation ponds would be decided based on water quality monitoring/effectiveness of the groundwater cutoff walls (see below).

Industrial water supply facilities including the Salmon River intake and piping system, and the Cherry Creek pump stations would be retained for use in long-term water management. Surface pipelines that are no longer required would be removed, and buried pipelines would be closed and left in place. As roads and other disturbed areas are reclaimed, ditches, sediment traps, ponds, and culverts would be removed and their surface disturbance reclaimed. Sediment ponds that are not required for long-term water management would be breached, recontoured, stabilized, and seeded.

Permanent diversion ditches would be fitted to the margins of the WRSFs to channel run-off around the WRSFs. The WRSFs would be recontoured to drain to their margins and to avoid ponding on their surfaces. Bruno Creek would be re-established across the reclaimed TSF. All permanent diversion ditches would be protected from erosion with riprap, gabions, vegetation or other means selected to ensure stability at the peak flow velocity for the ditch designs.

Pioneer (2010b) has provided location and design information for the WRSF diversion ditches post-reclamation (Section 2.1.4.6). The design for these ditches is the 500 year/24 hour storm, except for the Buckskin slope ditch which would be designed for the 100 year/24 hour storm (but the Buckskin Slope floodplain would manage the 500 year/24 hour storm). In general, for the Buckskin facility, a channel with a trapezoidal cross-section would be constructed along the north margin of the 8,100 foot bench (Buckskin perimeter channel) to carry run-off collected from the top of the bench and run-on from the adjacent natural slopes. The channel would be 6 feet wide on the bottom with 2H:1V side slopes and 3 to 6 feet deep. It would be lined with a 30 mil polyethylene membrane covered by 1 foot of earth. In flat reaches (< 1 % slope) the channel surface would be stabilized with grass. For channel reaches with moderate gradients (1 to 6 %) the channel surface would be stabilized with grass and then covered with UV-stabilized, polypropylene reinforcement mat (North American Green P550 or equivalent). In high gradient reaches (> 6 % slope), the channel surface would be stabilized with 1 foot of earth covered by 2 feet of riprap cemented together with grout. The perimeter channel would normally discharge to the Buckskin drainage downstream of the dump. It would also be possible to connect the perimeter channel with the pit channel described below.

In the approximate center of the upper Buckskin bench another trapezoidal channel (Buckskin cross swale channel) would be constructed with the same design characteristics as the perimeter channel. The objective of this channel would be to convey stormwater away from the crest of the reclaimed upper bench slope to the perimeter channel. The Buckskin pit channel would drain to the open pit via a channel built down the former haul road from the Buckskin upper bench. This channel would have the same design characteristics as the perimeter channel but would be stabilized with cemented riprap through its entire length due to its gradient.

Run-on and run-off for the Pat Hughes WRSF would be handled in similar fashion to that described for the Buckskin WRSF. A perimeter channel having the same design characteristics as the Buckskin perimeter channel would be built along the east margin of the 7,250 foot bench. The design cross section would range from 6 to 12 feet in width on the bottom with 2H:1V side slopes and depths ranging from 5 to 9 feet. This channel would discharge to the Pat Hughes natural channel location at the bottom toe of the WRSF. A Pat Hughes upper cross swale channel would be installed back from and parallel to the southern edge of the 7,250 foot bench to convey stormwater away from the crest of the reclaimed Pat Hughes WRSF. This channel would have similar design characteristics to the above described channels and would have a trapezoidal cross section with a 3 foot wide bottom, 2H:1V side slopes, and 2 foot depth.

Water draining from the Pat Hughes WRSF would be collected in a pipe and transferred to the Cherry Creek booster pump station via the Thompson Creek pipeline. From there it would be pumped uphill to a lime treatment plant adjacent to the open pit. Treated water from the plant would be discharged to the open pit lake. To ensure maximum collection of Pat Hughes facility seepage water, three groundwater cutoff walls (only one under Alternative M1), keyed into bedrock, would be constructed to limit groundwater discharge along Pat Hughes Creek and protect water quality in Thompson Creek.

Water draining from the Buckskin WRSF would be handled in similar manner to the Pat Hughes WRSF, with the exception that water from the Buckskin sedimentation pond may be discharged to Thompson Creek through NPDES Outfall 001 under certain conditions as described in the NPDES permit. This practice would continue long term in compliance with all terms and conditions of the NPDES permit. In the event that the Buckskin WRSF drainage water quality degrades to a level where seasonal discharge to Thompson Creek is not feasible, all drainage would be collected and routed through the Thompson Creek pipeline similar to the Pat Hughes WRSF. To protect groundwater quality downgradient from the Buckskin WRSF, one groundwater cutoff wall, keyed into bedrock, would be installed within the artesian groundwater zone at the base of the facility.

Flow from Bruno Creek would be routed in a channel constructed across the reclaimed TSF to a spillway in the southwest corner of the impoundment. The channel would have a trapezoidal cross section with a 6 foot wide bottom, 2H:1V side slopes, and 3 foot depth. The channel would have the capacity to pass approximately 230 cfs at bank-full conditions, which is greater than the 500 year/24 hour flood from the Bruno Creek watershed upstream of the TSF embankment. The channel would be lined with a polyethylene membrane liner and covered with 6 inches of earth and 12 to 18 inches of 1 foot median size riprap. The riprap is designed to withstand flow velocities of up to 10 cfs whereas the flow velocity in the channel at bank-full conditions is estimated to be less than 7 cfs.

The spillway channel would be excavated through native rock. The Bruno Creek channel through the impoundment would be routed to the spillway. Under normal conditions the water in the channel would flow unimpeded across the reclaimed surface of the TSF impoundment, i.e., the spillway would be designed to pass a maximum of 15 cfs of flow with no restrictions. Higher flows would be temporarily impounded to control flows through the spillway. The impoundment would have the capacity to temporarily store all the water collected during the probable maximum precipitation with freeboard.

The spillway would have a riprap-lined channel leading to a riprap-lined outlet channel. The outlet channel would lead to a natural drainage downhill from the TSF embankment into the Bruno Creek channel downstream of the TSF. This drainage would be protected from erosion under maximum flow by construction of an engineered channel. The engineered channel would have a trapezoidal cross section, 4 foot bottom width, 2H:1V side slopes, and minimum depth of 3 feet. The channel would be lined with a 2 foot thick blanket of 1 foot median size riprap.

Water draining from the toe drain system of the TSF embankment would continue to be collected in the SRD and downgradient pump-back wells for the long term. Upon initial TSF decommissioning, water flowing to the SRD would be pumped to the open pit to facilitate rapid flooding and submergence of the exposed mineralized intrusive rock. In addition, accumulated tailings water in the impoundment at initial decommissioning would also be pumped to the open pit in advance of reclamation of the tailings solids in the impoundment area. In the long term, water collected in the SRD impoundment and downgradient pump-back wells would be pumped to either a long-term water treatment facility or modify the existing PWTP. Treated water from this plant would meet the NPDES limits for Outfall 005 (Salmon River) and would be piped to this outfall for discharge.

Post-reclamation Environmental Monitoring

Post-reclamation monitoring would continue for water quality, geotechnical stability, revegetation success, and achievement of reclamation goals and objectives. The post-reclamation monitoring timeline differs between Alternatives M1 and M2 (Alternative M3 is the same as Alternative M2) (Table 2.1-4.; Table 2.1-7.), but under all alternatives the initial plans call for three monitoring periods – initial, interim, and post-reclamation – with the duration of each period being 5 years. However, adaptive management would be utilized to adjust these periods based upon the attainment of post-reclamation land use objectives (Section 2.1.1.9).

The initial monitoring period would begin upon cessation of mining (molybdenum production). During Years 1 to 5 the comprehensive environmental monitoring program conducted during mining would continue, and all reclamation (except that completed concurrent with mining) would be completed. Monitoring of revegetation at Year 5 would determine if successful ground cover (e.g., 70 %) was established. If not, additional seed and/or soil amendments would be applied and monitored for success. During the interim monitoring period (Years 6 to 10) sediment-related water quality would be stabilizing and vegetation would become established. Water quality monitoring for sediment, monitoring of revegetation, and monitoring WRSF geotechnical stability would end, assuming slope stability and water quality objectives have been achieved. By the start of the post-reclamation monitoring period (Years 11 to 15) all reclamation would be completed and sediment-related effects to water quality are expected to have stabilized. However, adaptive management provides the opportunity to adjust monitoring periods based on the need to modify or maintain reclamation work in order to achieve reclamation goals.

2.1.1.9. Adaptive Management

Adaptive management is an iterative decision process that promotes flexible decision making. Adaptive management can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood (DOI 2009). Adaptive management allows decision makers to determine if and when it is necessary or advisable to require adjustment of operating procedures, mitigation measures, and/or monitoring in response to key resource concerns identified through monitoring. Therefore, adaptive management helps ensure that permit and authorization requirements are met while providing sufficient flexibility to take preventative or remedial action if environmental concerns arise. However, the challenge in using adaptive management is in finding the correct balance between gaining knowledge to improve management in the future, and achieving the best short-term outcome based on the current knowledge (Allan and Stankey 2009; McDonald-Madden et al. 2010).

Adaptive management (Table 2.1-2.) would be utilized in conjunction with monitoring (Table 2.1-4.; Table 2.1-7.) to ensure reclamation goals are met. For example, if through monitoring, the goals of long-term water management were not being met (e.g., exceedances of WQSs) the IDEQ would require a response to define the potential concerns. Such response could lead to administrative changes in the long-term water management plan including additional groundwater cutoff walls, installation of reactive barriers, groundwater pumping, etc.

Table 2.1-2. Adaptive management strategy.

Item	Monitoring	Frequency	Threshold	Action	Authority	Responsible Party
TSF geotechnical stability	Visual inspections by TCMC Visual inspections and data review by IDWR Visual inspections by MSHA, IDL, BLM, and/or Forest Service Monthly survey data and standpipe soundings Analysis of samples of sand from standpipes during installation to check for potential precipitation formation Water level measurement	Daily inspections by TCMC of impoundment and documentation of volumes of materials placed in the TSF; monthly inspections by TCMC of embankment or inspections immediately after unusual seismic event felt at mine, major storm, or overflow Periodic inspections and data review by IDWR Periodic inspections by MSHA, IDL, BLM, and/or Forest Service Continuous, real-time water level data provided by fiber optic line to TCMC mill, engineering, and environmental/safety divisions Annual review of survey data by TCMC, TCMC contractors, and IDWR to ensure conformance with the TSF designs	Visible structural change in the embankment or surface of impoundment not in TSF design Rise in water level of > 2 feet in the embankment Measurement of < 12 feet of freeboard[1] Development of trees on TSF reclamation cap	Halt tailings disposal and water inflow from managed sources until inspection by qualified structural engineer Notify IDWR, MSHA, IDL, BLM, and/or Forest Service Pump water from impoundment surface until minimum freeboard re-established Remove trees on TSF reclamation cap Repair erosion damage Modify TSF design and/or operation Details in consolidated environmental monitoring plan (TCMC 2008a)	MMPO, TSF operating plan	TCMC, IDWR, MSHA, IDL, and/or BLM, Forest Service

Item	Monitoring	Frequency	Threshold	Action	Authority	Responsible Party
	Details in consolidated environmental monitoring plan (TCMC 2008a)					
WRSF geotechnical stability	Visual inspections by TCMC Visual inspections by MSHA, IDL, BLM, and/or Forest Service Monthly surveys Details in consolidated environmental monitoring plan (TCMC 2008a)	Daily inspections by TCMC or inspections by TCMC immediately after unusual seismic event felt at mine or major storm Periodic inspections by MSHA, IDL, BLM, and/or Forest Service Annual review of survey data by TCMC and its contractors to ensure development of WRSFs is per approved designs	Visible structural change to a WRSF not in facility design or design tolerance, e.g., abnormal tension cracks or oversteepened crest	Halt use of the affected area of WRSF until inspection by qualified structural engineer Notify MSHA, IDL, BLM, and/or Forest Service Modify WRSF design and/or operation	MMPO	TCMC, MSHA, IDL, BLM, and/or Forest Service
Open pit geotechnical stability	Visual inspections by TCMC Radar monitoring Visual inspections by MSHA, IDL, BLM, and/or Forest Service	Daily inspections by TCMC when personnel are in open pit or immediately after unusual seismic event felt at mine or major storm Continuous, real-time radar monitoring of active highwalls with data provided by fiber optic line to TCMC engineering and environmental/safety divisions Periodic inspections by MSHA,	Visible structural change not in facility design, e.g., unusual noises, fractures, or rockfall Acceleration of any part of a monitored highwall	Remove all personnel and equipment from the potentially affected area until inspection and evaluation by qualified structural engineer Notify MSHA, IDL, BLM, and/or Forest Service	MMPO	TCMC, MSHA, IDL, BLM, and/or Forest Service

Item	Monitoring	Frequency	Threshold	Action	Authority	Responsible Party
	Survey data	IDL, BLM, and/or Forest Service Annual review of survey data by TCMC and its contractors to ensure open pit developed per approved designs		Modify open pit design and/or operation		
Vegetation, forest resources, and invasive and non-native plants	Visual inspection of mine site for weeds by TCMC, IDWR, IDL, BLM, and/or Forest Service Visual inspection of seeded and planted reclaimed areas by TCMC, IDWR, IDL, BLM, and/or Forest Service	Bi-annual visual inspections for weeds by TCMC Periodic inspections by IDL, BLM, and/or Forest Service Monitoring of reclamation revegetation efforts in Year 1, annually Year 2+ by TCMC	Visual identification of weeds Failure of revegetation to obtain 70 % of the ground cover found on adjacent reference areas for two full growing seasons after cessation of soil amendment or irrigation (IDAPA 20.03.02.140.11.b)	Eradication of weeds Evaluation of site conditions, seed mixture/shrub and tree species, application/ planting methods and modify as appropriate to meet revegetation requirements	MMPO	TCMC, IDWR, IDL, BLM, and/or Forest Service
Water resources – surface water	Grab samples, recording measurements on-site, and/or calculations depending on parameters as required by NPDES permit (EPA 2007)	Continuous, daily, weekly, monthly, quarterly, or annually depending on parameter as required by NPDES permit (EPA 2007) Periodic inspection of data and reports by TCMC, EPA, IDEQ, IDL, BLM, and/or Forest Service	Exceedence of any parameters monitored by NPDES permit (EPA 2007) Statistically significant changes in trends of specified	Assess what caused the exceedence and provide corrective actions Modify water diversion/ interception/ infiltration control/ treatment methods	MMPO, EPA, IDEQ	TCMC, EPA, IDEQ, IDL, BLM, and/or Forest Service

Item	Monitoring	Frequency	Threshold	Action	Authority	Responsible Party
	Daily, weekly, and annual waste rock characterization and monitoring of waste rock handling by TCMC (Type 1 versus Type 2) Inspection of data and monitoring reports by TCMC, EPA, IDEQ, IDL, BLM, and/or Forest Service Details in consolidated environmental monitoring plan (TCMC 2008a)	Monthly review of analytical results of samples of drainage from WRSFs by TCMC	parameters Details in the consolidated environmental monitoring plan (TCMC 2008a)	Details in consolidated environmental monitoring plan (TCMC 2008a)		
Water resources – groundwater	Field and laboratory analysis of groundwater samples Inspection of data and monitoring	Bi-annual sampling and laboratory analyses by TCMC Periodic inspection of data and monitoring reports by TCMC, IDEQ, IDL, BLM, and/or Forest Service Details in consolidated	Exceedance of IDEQ WQSs or site-specific performance metrics, e.g., sulfate concentration Statistically	Mitigation is site specific depending on source characteristics, downstream receiving environments, and pathways that connect them Modify primary	MMPO, IDEQ	TCMC, IDEQ, IDL, BLM, and/or Forest Service

Item	Monitoring	Frequency	Threshold	Action	Authority	Responsible Party
	reports by TCMC, IDEQ, IDL, BLM, and/or Forest Service Details in consolidated environmental monitoring plan (TCMC 2008a) and Lorax (2012b)	environmental monitoring plan (TCMC 2008a) and Lorax (2012b)	significant changes in trends of specified parameters Details in consolidated environmental monitoring plan (TCMC 2008a) and Lorax (2012b)	mitigation which includes current water diversion/ interception for use in mill or post-closure treatment Modify secondary mitigation which includes proposed additional water diversion/ interception (e.g., groundwater cutoff walls) for use in mill or post-closure treatment Implement contingency mitigation which includes additional groundwater cutoff walls, permeable reactive barriers, and/or groundwater pumping wells Details in consolidated environmental monitoring plan (TCMC 2008a) and Lorax (2012b)		
Fish and aquatic	Fish and aquatic biology surveys[2]	Annually by TCMC	Reduction in fish counts or species	Evaluate the number of parameters sampled	MMPO	TCMC, IDEQ, IDL,

Item	Monitoring	Frequency	Threshold	Action	Authority	Responsible Party
resources	Details in consolidated environmental monitoring plan (TCMC 2008a) Inspections of data and reports by IDEQ, IDL, BLM, and/or Forest Service	Periodically by IDEQ, IDL, BLM, and/or Forest Service	diversity for two sampling periods	and expand as appropriate. Locate source of changes and take corrective actions Details in consolidated environmental monitoring plan (TCMC 2008a)		BLM, and/or Forest Service
Wetlands, floodplains, and riparian areas	Visual inspection of wetland mitigation sites for wetland development, vegetation cover, soils, hydrology, and use by wildlife as stated in wetland and stream mitigation plan (HDR 2014b, Appendix B) Visual inspection by USACE	Quarterly during first year after construction. Biannually after Year 1 through Year 5 (HDR 2014b) Periodic inspection by USACE	Lack of hydrologic, soil, and vegetative conditions that would allow the wetlands and stream banks to operate and function with minimal or no required maintenance or human intervention	Assess the cause of inadequate wetland function and rectify with soil treatments, weed control, vegetation protection, and/or supplemental planting as necessary	MMPO, USACE	TCMC, USACE

[1] *freeboard* is the height between the elevation of the upper water surface in the impoundment and the elevation of the crest of the embankment.
[2] Survey methods detailed in TCMC (2008a).

2.1.2. Alternative M1 – No Action

Alternative M1 is TCMC completing mining operations per the approved MPO; i.e., through Phase 7. The MPO was approved in 1980, but has since been modified many times during the last 30 years including a major modification in 1999 requiring a second EIS. The approved plan includes the reclamation plan (i.e., the consolidated reclamation plan, as amended). As described previously, the water management plan is also considered part of Alternative M1 even though such plan has not been approved by the agencies. That is, the no action alternative does not preclude the agencies from administratively accepting a water management plan within the scope of the MPO, approving the associated reclamation costs, or accepting an additional financial guarantee for implementation of the water management plan under Phase 7.

There are previously permitted (1980) areas of waste rock storage on Federal land that will not be used to complete Phase 7 (and would not be used under any of the other MMPO alternatives) (Figure 2.1-1). These areas are available because TCMC extracted more ore and less waste rock than originally planned. Using these areas for Phase 8 would not be economically, environmentally, or technically desirable. TCMC has no plans to use these areas as part of either Phase 7 or Phase 8. Therefore, these previously permitted areas will not be disturbed in Phase 7 and consequently are not analyzed under Alternative M1.[4]

The existing operations (Section 2.1.1.) have disturbed 2,822.6 acres, mostly owned by TCMC (Table 2.1-3., Figure 2.1-1). The limit of the Phase 7 pit and sustainable ore was reached at the end of 2011. Phase 7 ore production (from the base of the pit and entirely within the existing surface disturbance) would be completed by the end of 2016, with much of the reclamation (Section 2.1.1.8.) and post-reclamation monitoring (Table 2.1-4.) being completed 10 to 15 years later. Final surface disturbance would include the addition of waste rock to the WRSFs and tailings to the TSF generated during Phase 7 ore production.

Under Alternative M1 the mine would produce an additional 76 million pounds of molybdenum during Phase 7. The mine produced approximately 24 million pounds of molybdenum in 2011 (relatively high ore grade of 0.128 % molybdenum). Due to declining ore grade, the annual production would generally decrease to 12 million pounds (ore grade of 0.061 % molybdenum) in March 2016 at the end of Phase 7. The molybdenum would be produced from approximately 54 million tons of proven and probable ore reserves averaging 0.091 percent molybdenum with a cutoff of 0.03 percent molybdenum. Under Alternative M1 the TSF would contain approximately 235 million tons of tailings with a pre-reclamation embankment elevation of 7,646 feet (7,656 feet post-reclamation).

Active water treatment is not described in the approved reclamation plan for Alternative M1, but would have to be incorporated into the long term water management plan even if TCMC were to withdraw the proposed MMPO. Discharged water must meet all applicable laws and regulations, and active water treatment would be required. Therefore, active water treatment (Section 2.1.3.6.) is implicitly required.

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[4] Using these areas would require amendment of the consolidated reclamation plan, as the reclamation of the areas is not described in that plan.

Table 2.1-3. Existing surface disturbance (acres), Alternative M1.

Facility	TCMC	BLM	Forest Service
Buckskin WRSF	573.4	1.4	41.9
Pat Hughes WRSF	293.1	81.4	0.0
Open pit	491.2	0.0	0.0
TSF (estimated)	463.6	3.3	7.6
Operational area – other	253.5	122.6	1.1
Roads	38.4	73.9	44.3
Power line	62.5	138.4	83.6
Pipeline	14.5	29.3	2.8
Fiber optic cable	0.3	0.6	0.0
TOTAL	**2,190.5**	**450.9**	**181.3**
	2,822.6		

Table 2.1-4. Post-reclamation monitoring, Alternative M1.

Monitoring	Years 1-5	Years 6-10	Years 11-15
Sediment sampling	X		
Aquatic biota and habitat	X	X	X
Surface water quality	X	X	X
Groundwater quality	X	X	X
Receiving stream	X	X	X
TSF area water	X	X	X
TSF geotechnical	X	X	X
TSF revegetation	X	X	
Waste rock geotechnical	X	X	
Waste rock revegetation	X	X	
Other revegetation	X	X	

2.1.3. Alternative M2 – MMPO as Submitted by TCMC

In December 2008 and January 2009 TCMC submitted an MMPO to the BLM, Forest Service, and other cooperating agencies. A revision to the MMPO was submitted in October 2009 (TCMC 2009). The MMPO describes Phase 8 mining (Alternative M2, the proposed action). The differences between this alternative and Alternative M1 are the following:

- The mine life would be 9 years longer;
- A section of power line would be relocated;
- The open pit would be deepened and widened to mine Phase 8 ore;
- The Buckskin and Pat Hughes WRSFs would be expanded and used to store Phase 8 waste rock;
- The TSF embankment would be raised and the TSF impoundment expanded to store the tailings produced from milling Phase 8 ore;
- The long-term water management plan would be modified because of the size and configuration of the Phase 8 facilities and the need for water treatment to ensure WQSs are met (Lorax 2012a); and
- Two additional groundwater cutoff walls would be installed in the Pat Hughes drainage.

Under Alternative M2 there would be additional surface disturbance on 110.0 acres of TCMC land and 385.6 acres of Federal lands as compared to Alternative M1 (Figure 2.1-4., Table 2.1-5., Table 2.1-6). Of this disturbance, 3.39 acres of wetlands and 10,641 linear feet of stream channel designated as WUS would be subject to a 404 permit from the USACE.

Table 2.1-5. Additional disturbance, Alternative M2.

Facility	TCMC Additional (acres)	TCMC Total (acres)	BLM Addl. (acres)	BLM Total (acres)	Forest Service Addl. (acres)	Forest Service Total (acres)
Buckskin WRSF	8.0	581.4	0.0	1.4	54.4	96.4
Pat Hughes WRSF	19.0	312.1	170.9	252.3	0.0	0.0
Open pit	0.0	491.2	0.0	0.0	0.0	0.0
TSF (estimated)	68.0	531.6	10.5	13.8	52.7	60.3

Facility	TCMC Additional (acres)	TCMC Total (acres)	BLM Addl. (acres)	BLM Total (acres)	Forest Service Addl. (acres)	Forest Service Total (acres)
Operational area – other	12.1	265.6	16.6	139.2	41.7	42.8
Roads	0.0	38.4	0.0	73.9	0.0	44.3
Power line	0.1	62.6	0.0	138.4	21.9	105.5
Pipeline	2.8	17.3	2.1	31.4	14.8	17.6
Fiber optic cable	0.0	0.3	0.0	0.6	0.0	0.0
TOTAL	**110.0**	**2300.5**	**200.1**	**651.0**	**185.5**	**366.9**

Includes Phase 8 mining operations proposed on currently unpermitted and permitted (1980) land

Table 2.1-6. Comparison of final disturbance between Alt. M1 and Alt. M2.

Facility	Alt. M1 TCMC (acres)	Alt. M2 TCMC (acres)	Alt. M1 BLM (acres)	Alt. M2 BLM (acres)	Alt. M1 Forest Service (acres)	Alt. M2 Forest Service (acres)
Buckskin WRSF	573.4	581.4	1.4	1.4	41.9	96.4
Pat Hughes WRSF	293.1	312.1	81.4	252.3	0.0	0.0
Open pit	491.2	491.2	0.0	0.0	0.0	0.0
TSF	463.6	531.6	3.3	13.8	7.6	60.3
Operational area – other	253.5	265.6	122.6	139.2	1.1	42.8
Roads	38.4	38.4	73.9	73.9	44.3	44.3
Power line	62.5	62.6	138.4	138.4	83.6	105.5
Pipeline	14.5	17.3	31.4	31.4	2.8	17.6
Fiber optic cable	0.3	0.3	0.6	0.6	0.0	0.0
TOTAL	**2,190.5**	**2,300.5**	**453**	**651.0**	**181.3**	**366.9**

2.1.3.1. Transportation, Access, and Power

Under Alternative M2, 4,900 feet of an existing 24.9 kV power line on NFS land ("Phase 8 power line," Figure 2.1-4.) would be relocated on NFS land in the area northeast of the open pit. The relocation would be necessary because of expansion of the open pit. The relocated utility corridor (200 feet wide, 21.9 acres of surface disturbance) would be on a ridge between Bruno Creek and the head of Pat Hughes Creek, and would pass through the upper portion of the Buckskin drainage (basin) (Figure 2.1-4). The corridor would be periodically cleared of trees for fire protection, and a vehicle access route would be maintained within the corridor. The power line would require maintenance including the possible replacement of equipment on an as-needed basis during mining. The total widths of all mine transportation and utility corridors within the MMPO area would be the following: power lines (200 feet), roads (12-70 feet), fiber optic lines (30 feet), pipelines (40 feet).

2.1.3.2. Mining Operations

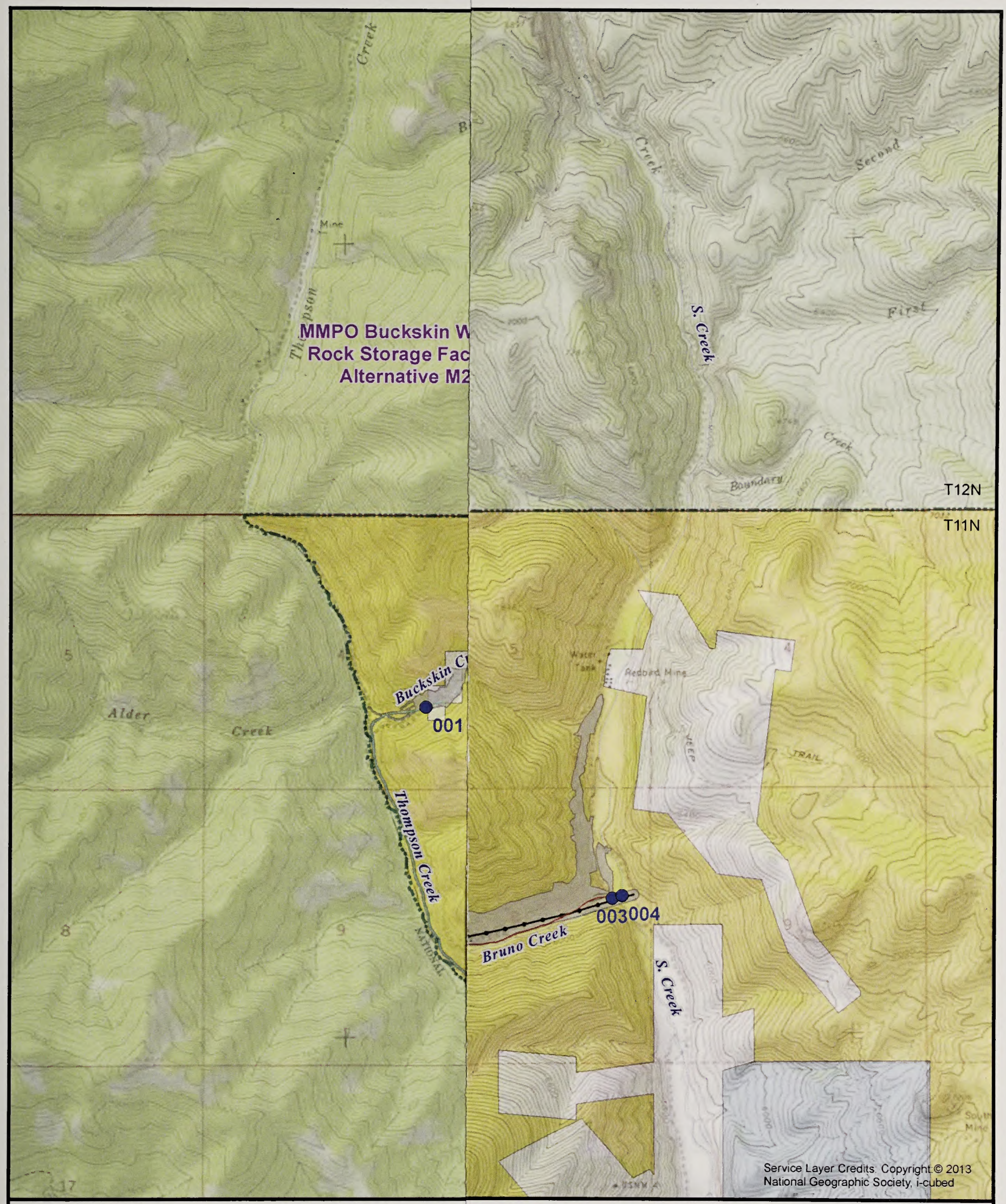
Under Alternative M2 molybdenum production would continue to 2025 (instead of 2016 under Alternative M1), with most reclamation completed 10 to 15 years later. The mine would produce an additional 131 million pounds of molybdenum as compared to Alternative M1. The molybdenum would be produced from approximately 143 million tons of proven and probable ore reserves averaging 0.073 percent molybdenum with a cutoff of 0.03 percent molybdenum. The MMPO would use the same facilities and transportation/access system as under Alternative M1 (Section 2.1.1).

The Phase 8 mining would occur in two subphases – Phase 8 West and Phase 8 East – for which there are detailed designs.[5] The Phase 8 West overburden removal began in 2012[6] (on TCMC land for which no Federal approval was required) at the end of the Phase 7 overburden removal, and would be completed in 2025; the bulk of the overburden would be removed by 2017 but 7 percent would be removed between 2018 and 2025. The Phase 7 ore removal would continue to approximately 2016 when the Phase 7 ore would be depleted. At that time, the Phase 8 West ore would be exposed. The mill would use the Phase 8 West ore from approximately 2016 until the Phase 8 West ore would be depleted in approximately 2025. The approximately 144 million tons of the Phase 8 West waste rock would be placed in the existing Buckskin and Pat Hughes WRSFs (Figure 2.1-4). The width of the overall slice of the Phase 8 West overburden that would be removed would vary from 500 feet at the southern end to 1,000 feet at the northern end, with an approximate height of 1,600 feet. Ore production from the Phase 8 West expansion would be approximately 68 million tons. The Phase 8 West pit expansion would be entirely on TCMC land.

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[5] The analysis of Alternative M2 is of full Phase 8 development and is not dependent on the currently proposed subphases of Phase 8 development.

[6] TCMC suspended Phase 8 overburden removal in October 2012 due to depressed molybdenum prices and the need to maximize cash earnings for TCMC's parent company. However, TCMC intends to restart the overburden removal when molybdenum prices increase (TCMC 2012a). Therefore, the timing of completion of the Phase 8 components (and their effects) could be delayed. Such is just one example of how the projected dates of mining activity listed herein are necessarily approximate.



iences.

Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- Existing embankment crest
- Proposed embankment crest
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land

Figure 2.1-4
Alternative M2 - MMPO as submitted by TCMC
Thompson Creek Mine EIS

2.1.3.1. Transportation, Access, and Power

Under Alternative M2, 4,900 feet of an existing 24.9 kV power line on NFS land ("Phase 8 power line," Figure 2.1-4.) would be relocated on NFS land in the area northeast of the open pit. The relocation would be necessary because of expansion of the open pit. The relocated utility corridor (200 feet wide, 21.9 acres of surface disturbance) would be on a ridge between Bruno Creek and the head of Pat Hughes Creek, and would pass through the upper portion of the Buckskin drainage (basin) (Figure 2.1-4). The corridor would be periodically cleared of trees for fire protection, and a vehicle access route would be maintained within the corridor. The power line would require maintenance including the possible replacement of equipment on an as-needed basis during mining. The total widths of all mine transportation and utility corridors within the MMPO area would be the following: power lines (200 feet), roads (12-70 feet), fiber optic lines (30 feet), pipelines (40 feet).

2.1.3.2. Mining Operations

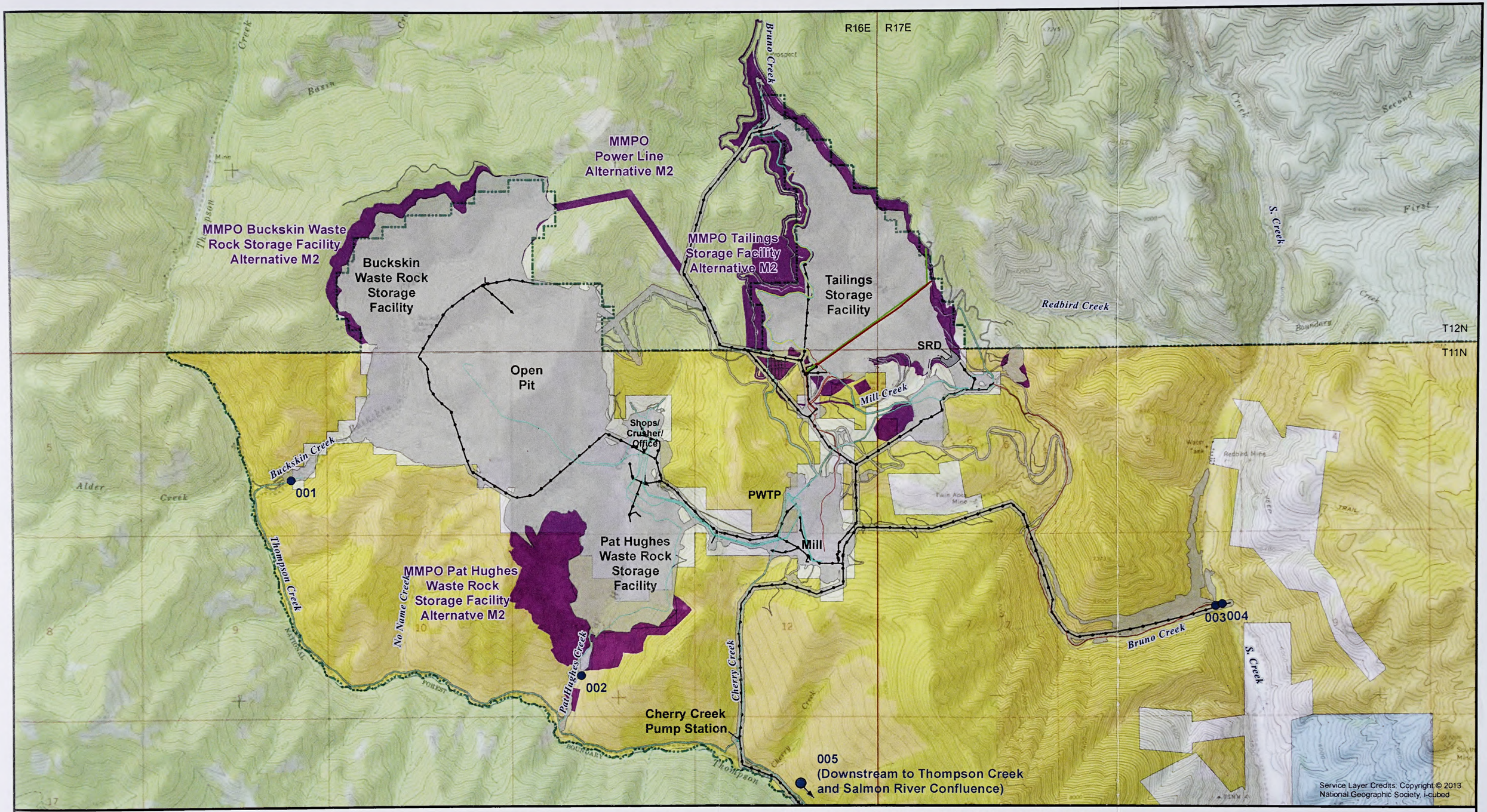
Under Alternative M2 molybdenum production would continue to 2025 (instead of 2016 under Alternative M1), with most reclamation completed 10 to 15 years later. The mine would produce an additional 131 million pounds of molybdenum as compared to Alternative M1. The molybdenum would be produced from approximately 143 million tons of proven and probable ore reserves averaging 0.073 percent molybdenum with a cutoff of 0.03 percent molybdenum. The MMPO would use the same facilities and transportation/access system as under Alternative M1 (Section 2.1.1).

The Phase 8 mining would occur in two subphases – Phase 8 West and Phase 8 East – for which there are detailed designs.[5] The Phase 8 West overburden removal began in 2012[6] (on TCMC land for which no Federal approval was required) at the end of the Phase 7 overburden removal, and would be completed in 2025; the bulk of the overburden would be removed by 2017 but 7 percent would be removed between 2018 and 2025. The Phase 7 ore removal would continue to approximately 2016 when the Phase 7 ore would be depleted. At that time, the Phase 8 West ore would be exposed. The mill would use the Phase 8 West ore from approximately 2016 until the Phase 8 West ore would be depleted in approximately 2025. The approximately 144 million tons of the Phase 8 West waste rock would be placed in the existing Buckskin and Pat Hughes WRSFs (Figure 2.1-4). The width of the overall slice of the Phase 8 West overburden that would be removed would vary from 500 feet at the southern end to 1,000 feet at the northern end, with an approximate height of 1,600 feet. Ore production from the Phase 8 West expansion would be approximately 68 million tons. The Phase 8 West pit expansion would be entirely on TCMC land.

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[5] The analysis of Alternative M2 is of full Phase 8 development and is not dependent on the currently proposed subphases of Phase 8 development.

[6] TCMC suspended Phase 8 overburden removal in October 2012 due to depressed molybdenum prices and the need to maximize cash earnings for TCMC's parent company. However, TCMC intends to restart the overburden removal when molybdenum prices increase (TCMC 2012a). Therefore, the timing of completion of the Phase 8 components (and their effects) could be delayed. Such is just one example of how the projected dates of mining activity listed herein are necessarily approximate.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- Existing embankment crest
- Proposed embankment crest
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.1-4
MMPO Alternative M2 - MMPO as submitted by TCMC
Thompson Creek Mine EIS

The Phase 8 East overburden removal would begin 1 year after the start of the Phase 8 West overburden removal, and would progress concurrently with the Phase 8 West expansion until the Phase 8 East overburden removal was completed in 2022. The Phase 8 East waste rock would be placed in the existing Buckskin and Pat Hughes WRSFs. The overall slice of the Phase 8 East overburden that would be removed would be approximately 250 feet in width and 2,100 feet in height. Ore production from the Phase 8 East expansion would be approximately 31 million tons. The mill would use the Phase 8 East ore from 2014 when the ore would be first exposed to 2022 when the ore would be depleted. The Phase 8 East pit expansion would be entirely on TCMC land. The base of the pit under Alternative M2 would be at an elevation of 6,100 feet.

2.1.3.3. Waste Rock Storage Facilities

Under Alternative M2 263.5 million tons of waste rock would be removed and stored in the Buckskin (upper Buckskin) (107.7 million tons) and Pat Hughes (lower Pat Hughes) (155.8 million tons) WRSFs (Figure 2.1-4). These areas were selected for haul road accessibility (e.g., distance and gradient), low mineral potential, and geotechnical requirements. The expansion of the WRSFs would occur on both private and Federal land (Table 2.1-4). The Pat Hughes sediment control pond (sedimentation pond) would be relocated to the base of the final toe of the Pat Hughes WRSF.

2.1.3.4. Mill and Tailings Operations

Milling the Phase 8 East and Phase 8 West ore would require additional tailings storage capacity, which would be accomplished by raising and partially re-aligning the TSF embankment crest compared to that at the end of Phase 7 (Figure 2.1-1., Figure 2.1-4). The embankment is constructed of sand deposited by the header pipeline along the length of the crest of the embankment (Section 2.1.1.5). In this case, to address a topographic low section in the eastern abutment upgradient of the existing crest, a compacted cyclone sand dam would be constructed, filling in the topographic low section. The angled crest would be approximately 1,000 feet long, 200 feet wide, and up to 100 feet above the original ground surface (Golder 2012). This modification is expected to be approved by the IDWR prior to the completion of the EIS, and this modification was also evaluated by the agencies as part of preparing this FEIS. Therefore, this modification is considered to be part of Alternative M2 and Alternative M3. The modification would increase the capacity of the TSF by 100 to 125 million tons, which would provide adequate space for the tailings produced during Phase 8. The TSF is permitted to store approximately 240 million tons of tailings through the end of Phase 7 (Alternative M1), and approximately 335 million tons at the end of Phase 8 (Alternative M2).

The TSF embankment would be raised to 7,742 feet before reclamation (from 7,646 feet at the end of Phase 7) to provide sufficient storage in the upgradient impoundment (filling the Bruno drainage). The embankment would continue to be constructed of sand from cycloned tailings deposited by the header pipeline (Golder 2008). To reduce the downgradient surface disturbance and the amount of sand required for embankment construction, the downgradient embankment slope would be increased from 3H:1V to 2.75H:1V. The elevation of the rock toe embankment underlying the lower face of the embankment would be raised to 6,960 feet.

2.1.3.5. Environmental Controls and Monitoring

TCMC would utilize the same environmental controls and monitoring under Alternative M2 as would be used under Alternative M1 (Section 2.1.1). TCMC has a BMP plan (TCMC 2010a) and SPCC plan (ARCADIS 2010) that superseded its initial pollution prevention plan. The goal of these plans is to prevent or minimize the generation and the potential for release of pollutants from the mine site. The BMP plan includes the types of monitoring proposed to track the effectiveness of the various environmental protection measures. Additionally, an adaptive groundwater management plan (Lorax 2012b) was developed that includes the water management strategies and mitigation necessary to minimize the MMPO effects to water resources. Adaptive management strategies (Section 2.1.1.9.) would allow for adjustment of operating procedures, mitigation measures, and/or monitoring in response to key resource concerns identified through monitoring.

In order to comply with the MBTA and other direction (Section 1.9.6) and the BGEPA (Section 1.9.7), the following measures would be implemented during all habitat–clearing activities, particularly timber harvest, power line relocation, and pipeline construction:

1) Timber harvest, power line relocation, and pipeline construction would be scheduled for outside of the general nesting season (April 15 – July 31), or as late in the nesting season as possible.
2) Migratory bird habitat within planned disturbance areas would be grubbed (habitat removal or rendering habitat unsuitable for nesting) to the maximum extent practicable during winter prior to construction, when migratory birds are least likely to be present, and to prevent migratory birds from using the habitat and being encountered during pre-construction surveys.
3) Activities would be avoided during the general nesting season (April 15 – July 31). Prior to activities that must take place during the general nesting season, TCMC would perform surveys for migratory bird nests to the maximum extent possible within the disturbance areas, including for sensitive species.
4) Prior to any habitat removal during which raptors may be nesting (February 1 – August 31), TCMC would also perform surveys for raptors, including for sensitive species.
5) If an active nest is found, the nest and a surrounding buffer area would be avoided until birds have fledged. An exception to this restriction may be granted by the BLM due to natural screening or other factors that may reduce noise impacts.
6) Note that bald eagles may be nesting as early as January. If an active bald eagle nest is found, the regional USFWS office and BLM should be contacted immediately as any disturbance of bald eagles is a violation of the BGEPA.

Under the action alternatives, construction in stream channels would occur during low flows, and the channels and banks would be stabilized against erosion as part of the initial construction.

2.1.3.6. Reclamation

Reclamation would generally be the same for Alternative M2 (Phase 8) as it would be for Alternative M1 (Phase 7) (Section 2.1.1.8.), except as summarized in this section. Active water treatment is not described in the approved reclamation plan for Alternative M1, but would have to be incorporated into the long term water management plan even if TCMC were to withdraw the proposed MMPO. Discharged water must meet all applicable laws and regulations, and active water treatment would be required. Therefore, active water treatment (Section 2.1.3.6.) is implicitly required.

At the end of Phase 8, the Buckskin WRSF would consist of an upper and middle bench between 8,200 to 7,600 feet and a lower bench at 7,600 to 6,650 feet elevation. The face (slope) between the upper benches would be graded to 2.5H:1V. All of the surface of the facility would be Type 1 waste rock (except the lower bench face), and there would be no cells of Type 2 waste rock within 150 feet of the surface. A portion of the surface of the upper bench would be capped with 1 foot of growth material and revegetated. The rest of the upper bench and all of the middle bench would be graded (no soil cap), scarified (ripped), and revegetated, except the slope below the other middle bench which drains directly to the open pit would remain at the angle of repose (~ 1.5H:1V) and would be capped with 3 feet of non-volcanic, durable Type 1 rock (Doughty 2013).

At the end of Phase 8, the Pat Hughes WRSF would have four benches at 7,850 to 7,350 feet; 7,350 to 7,000 feet; 7,000 to 6,750 feet; and 6,750 to 6,250 feet elevation. The highest bench (7,850 feet) would be comprised of all Type 1 volcanic materials and would be largely removed at final reclamation and used for cover material. The slope between the 7,350 and 7,000 foot benches would be recontoured to a slope of 3H:1V as would the slope between the 7,000 and 6,750 foot benches. The slope downhill from the 6,750 foot bench would remain at angle of repose. All slopes would be covered with durable, non-volcanic, Type 1 waste rock.

The final configurations of the TSF impoundment, embankment, and spillway are described in the Phase 8 Tailings Impoundment Reclamation Plan and Cost Estimate (WMC 2008). The reclamation of the TSF under Alternative M2 would be the same as that under Alternative M1 (Section 2.1.1.8.), except the footprint of the facility would be slightly larger, the final reclaimed height of the embankment would be 7,752 feet instead of 7,656 feet, and the spillway would be constructed through native rock at an elevation of 7,722 feet.

All modifications to the long-term water management plan would be consistent with the existing NPDES permit, which sets limits for the allowable discharges of all constituents of potential concern. The permit would be renewed over time pursuant to 40 CFR 122, and the limits would be expected to change in the long term.

As part of Alternative M2, TCMC would either construct a long-term water treatment facility or modify the existing PWTP. TCMC would also, on a long-term basis, collect water from the WRSFs and TSF and route this water to the open pit and eventually to the water treatment facility. The WRSF cutoff walls, which would be installed during operations, would remain in place throughout reclamation. The collected water would fill the pit at an accelerated rate to the control elevation of 7,030 feet to minimize oxidation of the pit walls. The water level in the pit

would be maintained at this elevation to avoid the potential of water leaving the southeast end of the pit via an exploration adit (sealed), and to maintain a cone of depression, i.e., keep groundwater flowing into the pit to minimize the potential for mine-affected waters to affect off-site groundwater.

The sedimentation ponds below the WRSFs and the SRD and pump-back sump/station below the TSF would be maintained as permanent features to collect drainage from these facilities, which would be pumped through pipelines to the open pit, and eventually to the water treatment plant. The treated water would then be discharged via pipelines to either Outfall 002 at the confluence of Pat Hughes Creek and Thompson Creek, or Outfall 005 near the confluence of Thompson Creek and the Salmon River (Figure 2.1-4). The difference under Alternative M2 in the post-reclamation monitoring as compared to that under Alternative M1 is that some monitoring could continue for longer durations (Table 2.1-7).

Table 2.1-7. Post-reclamation monitoring, Alternative M2.

Monitoring[1]	Years
Sediment sampling	5+
Aquatic biota and habitat	16+
Surface water quality	16+
Groundwater quality	16+
Receiving stream	16+
TSF water	15+
TSF geotechnical	15+
TSF revegetation	10+
Waste rock geotechnical	10+
Waste rock revegetation	10+
Other revegetation	10+

[1] beyond that of Alternative M1

2.1.4. Alternative M3 – No Name Waste Rock Storage Facility

This alternative is similar to Alternative M2, except that the No Name WRSF would contain approximately 115 million tons of waste rock on 232.9 acres of currently undisturbed BLM land (Photo 2.1-19., Photo 2.1-20). The WRSF would include a downgradient sedimentation pond. The location is economically favorable for waste rock storage due to the proximity of the No Name drainage to the open pit and a level to downgradient loaded haul. Accordingly, under Alternative M3, less waste rock would be placed in the Buckskin and possibly the Pat Hughes WRSFs, and these WRSFs would have smaller overall footprints than under Alternative M2 (Figure 2.1-5., Table 2.1-8). Under Alternative M3, compared to Alternative M2, there would be an additional 0.05 acres of disturbance in wetlands and an additional 5,563 linear feet of designated WUS subject to a 404 permit from the USACE.

Table 2.1-8. Comparison of (final) disturbance between Alt. M3 and Alt. M2.

Facility	Alt. M2 TCMC (acres)	Alt. M3 TCMC (acres)	Alt. M2 BLM (acres)	Alt. M3 BLM (acres)	Alt. M2 Forest Service (acres)	Alt. M3 Forest Service (acres)
No Name WRSF	0.0	0.6	0.0	232.9	0.0	0.0
Buckskin WRSF	581.4	573.4	1.4	1.4	96.4	42.4
Pat Hughes WRSF	312.1	299.0	252.3	237.3	0.0	0.0
Open pit	491.2	491.2	0.0	0.0	0.0	0.0
TSF (estimated)	531.6	531.6	13.8	13.8	60.3	60.3
Operational area – other	265.6	265.6	139.2	139.2	42.8	42.8
Roads	38.4	38.4	73.9	73.9	44.3	44.3
Power line	62.6	62.6	138.4	138.4	105.5	105.5
Pipeline	17.3	17.3	31.4	31.4	17.6	17.6
TOTAL	**2,300.2**	**2,279.7**	**650.4**	**868.3**	**366.9**	**312.9**

Includes mining operations proposed on currently unpermitted and permitted (permitted in 1980) land.

2.1.5. MMPO Alternatives Comparison/Exposure to Risk

Each alternative relies on engineered systems to contain the waste rock and tailings, and to manage the water that contacts the mine in perpetuity.[7] In particular, the post-reclamation water management would be required to assure that water leaving the mine would meet the current WQSs. The waste rock and tailings storage facilities would safely withstand the maximum credible earthquake under all of the MMPO alternatives (Section 4.2.1). However, the water management system consists of a series of collection points, pipelines, pump stations, and treatment plants. These facilities, during operations of 100s years or more, could be subject to equipment failures (e.g., pipeline rupture), human error (e.g., a valve improperly opened), or extended power outages (e.g., earthquake damages to the regional electricity grid). Such problems may be inevitable over the course of 100s of years or more, and could result in the release of untreated water to the environment.

It is not possible to predict how such problems would occur or what the consequences would be, as such would depend on what water was released, where and how much water was released, and the duration and timing of the release. However, in the worst case, the release of untreated water

[7] an indefinite time period of 100s of years or more, e.g., the drainage from the waste rock and tailings storage facilities could not have elevated concentrations of metals forever – there are only finite amounts of metals in the WRSFs and TSF available for preferential dissolution

could cause exceedances of acute WQSs in sections of the Salmon River, Thompson Creek, S. Creek, and Bruno Creek. There would be no material difference in such risk (probability and consequence) between Alternative M1 and Alternative M2 for which water with similar chemistry would be treated by essentially the same facilities. In the case of Alternative M3, the risk would be slightly greater due to the addition of a new source of water to be treated (new WRSF) and the additional water collection and transport facilities to connect the new source to the main facilities. However, the primary effect would be to Thompson Creek, which could also be affected by the release of untreated water under Alternative M1 or Alternative M2 (the Buckskin, No Name, and Pat Hughes tributaries to Thompson Creek would be part of the mine water management system under the respective MMPO alternatives, and not natural streams). The adaptive groundwater management plan (Lorax 2012b) offers three mitigation contingencies in the event that "specified Performance Metrics" are exceeded. These include a slurry wall, a permeable reactive barrier, and additional pumping wells within the vicinity of the existing pump-back system.

The environmental effects of the MMPO alternatives are described in detail in Chapter 4; Section 4.1 includes the definition of the magnitudes and durations of effects specific to each resource. The key environmental effects of the MMPO alternatives are compared below (Table 2.1-9).



Photo 2.1-19. No Name drainage, view to southwest.

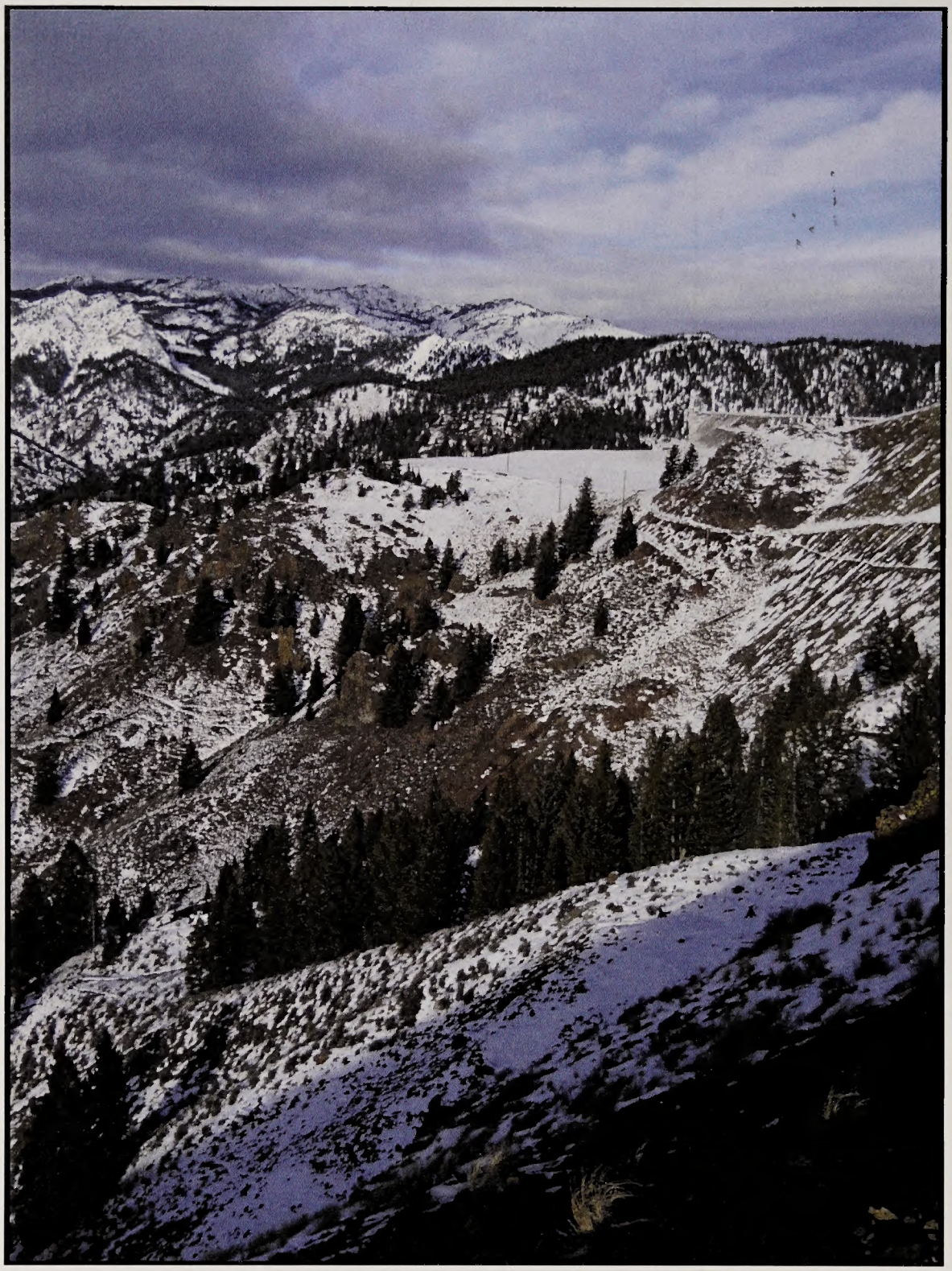
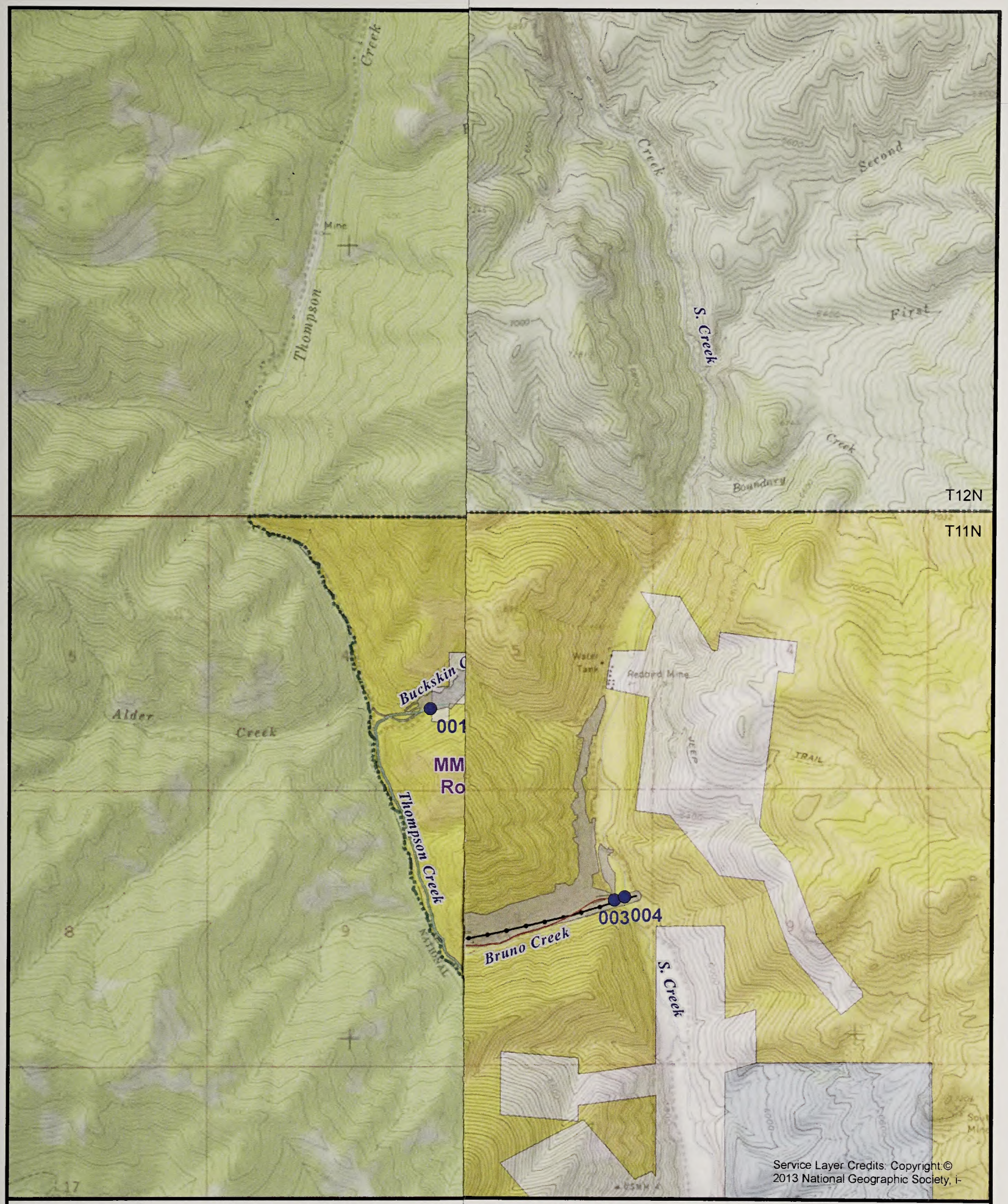


Photo 2.1-20. No Name drainage, view to northwest.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M3
- Existing embankment crest
- Proposed embankment crest
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Figure 2.1-5
MMPO Alternative M3 - No Name WRSF
Thompson Creek Mine EIS

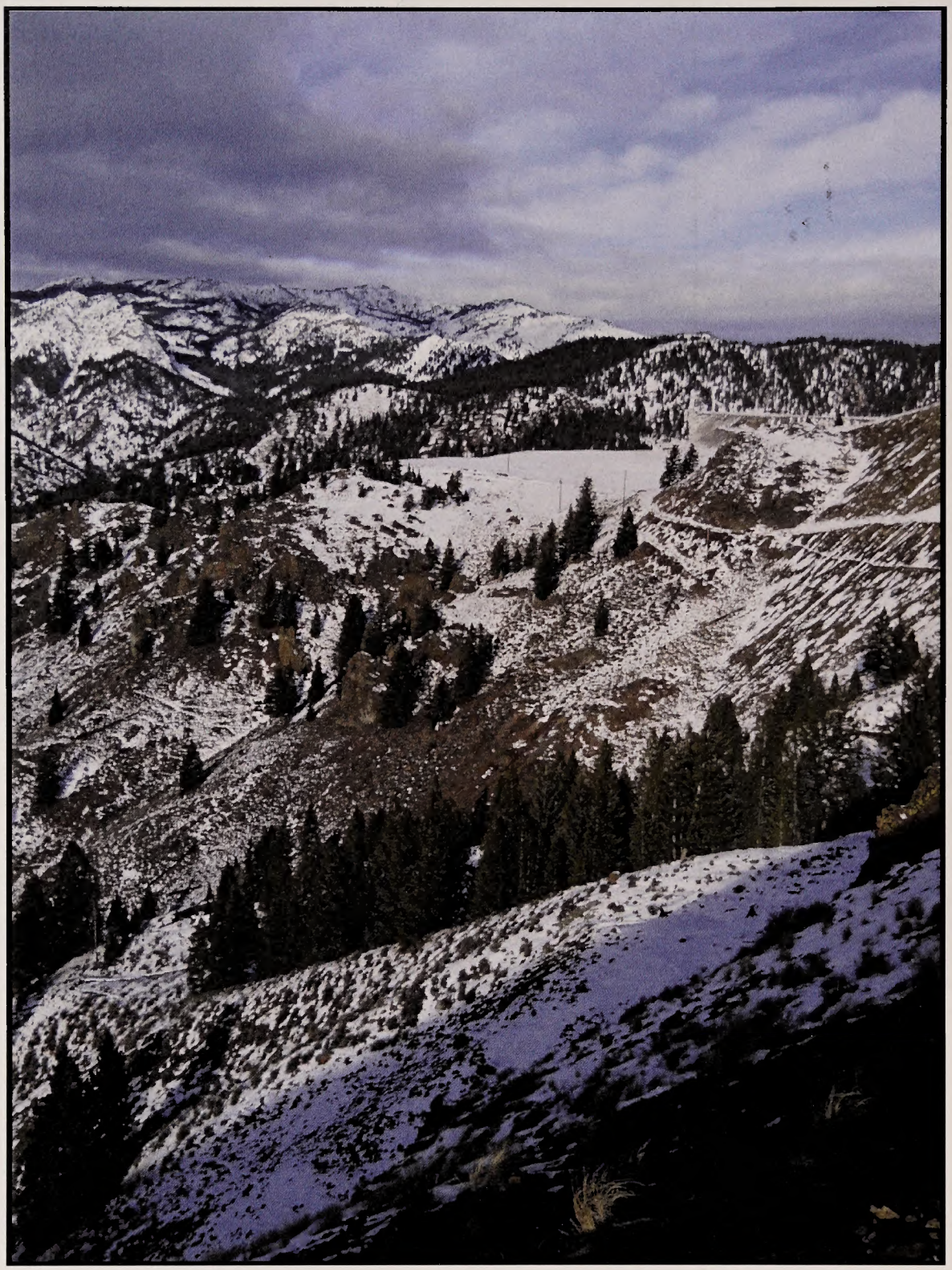


Photo 2.1-20. No Name drainage, view to northwest.

R16E R17E

T12N

T11N

MMPO Power Line Alternative M3

MMPO Tailings Storage Facility Alternative M3

Buckskin Waste Rock Storage Facility

Tailings Storage Facility

Open Pit

SRD

Shops/ Crusher/ Office

PWTP

Mill

MMPO No Name Waste Rock Storage Facility Alternative M3

Pat Hughes Waste Rock Storage Facility

MMPO Pat Hughes Waste Rock Storage Facility Alternative M3

Cherry Creek Pump Station

001

002

003004

005 (Downstream to Thompson Creek and Salmon River Confluence)

Bruno Creek

Redbird Creek

Mill Creek

Buckskin Creek

Thompson Creek

No Name Creek

Pat Hughes Creek

Cherry Creek

S. Creek

Alder Creek

Service Layer Credits: Copyright © 2013 National Geographic Society, i-

Legend

- Existing mining disturbance
- MMPO areas/Alternative M3
- Existing embankment crest
- Proposed embankment crest
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline
- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Alternative data from Thompson Creek Mine drawing files and converted to shapefiles.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.1-5
MMPO Alternative M3 - No Name WRSF
Thompson Creek Mine EIS

Table 2.1-9. Effects comparison, MMPO alternatives.

Indicator	Alternative M1	Alternative M2	Alternative M3
GEOLOGIC RESOURCES AND GEOTECHNICAL ISSUES			
Molybdenum production	Increase in world molybdenum production of 73 million pounds (short-term, moderate effect)	Increase in world molybdenum production of 204 million pounds (short-term, moderate effect)	Same as Alternative M2
Molybdenum reserves	Decrease in world molybdenum reserves by 73 million pounds (short-term, minor effect)	Decrease in world molybdenum reserves by 204 million pounds (short-term, minor effect)	Same as Alternative M2
Paleontological sites	No change to existing conditions	No change to existing conditions	No change to existing conditions
SOIL RESOURCES			
Soil productivity	No change to existing conditions	384.9 acres of permanent effects (negligible to moderate) and 112.1 acres of temporary effects (negligible to moderate)	526.5 acres of permanent effects (negligible to moderate) and 112.1 acres of temporary effects (negligible to moderate)
VEGETATION, FOREST RESOURCES, AND INVASIVE AND NON-NATIVE PLANTS			
Area of special status[1] plant habitat disturbed	No change to existing conditions	497.0 acres of suitable sensitive plant habitat disturbed (no records of occurrence); may affect individual plants but would not cause a trend towards listing	640.6 acres of suitable sensitive plant habitat disturbed (no records of occurrence); may affect individual plants but would not cause a trend towards listing
Area of forest habitat disturbed	No change to existing conditions	391.0 acres forest habitat (2,548 mbf)[2] harvested (long-term, moderate effect)	487.2 acres forest habitat (3,169 mbf) harvested (long-term, moderate effect)
Change in carbon sequestration	No change to existing conditions	No effect on existing conditions	No change to existing conditions
RANGE RESOURCES			
Change in AUMs[3]	No change to existing conditions	4 % decrease (long-term, minor effect)	6 % decrease (long-term, minor effect)

Indicator	Alternative M1	Alternative M2	Alternative M3
WATER RESOURCES			
Water quality - turbidity, concentrations of suspended sediment, and COCs	During mining/after cutoff wall installation: decreased concentrations of most constituents in Thompson Creek; increased concentrations of some constituents over time would still meet WQSs[4] for all parameters under conditions analyzed. After mining: increased concentrations of some constituents in S. Creek, but would be within WQSs except for cadmium for the conservative upper estimates/7Q10 low flow condition; discharge from Outfall 005 to the Salmon River would need to meet all NPDES permit limits	During mining/after cutoff wall installation: decreased concentrations of most constituents in Thompson Creek; increased concentrations of some constituents over time would meet WQSs for all parameters with the exception of copper for the conservative upper estimate/7Q10 low flow condition (long-term, moderate effect); negligible effect to Thompson Creek, Bruno Creek, and S. Creek from sediment delivery After mining: increased concentrations of some constituents in S. Creek; would be within WQSs except for cadmium for the conservative upper estimates/7Q10 low flow condition; discharge from Outfall 005 to the Salmon River would need to meet all NPDES permit limits	Same as Alternative M2
Water quantity - discharge	During mining/after cutoff wall installation: negligible or minor reduction in flow in Thompson Creek After mining: negligible effects to flow in Bruno Creek and S. Creek; negligible to minor effects to flow in Salmon River (depending on flow) due to cessation of removal of water for mine processes	During mining: negligible to minor reduction in flow in Thompson Creek and S. Creek from cutoff walls After mining: negligible effects to flow in Bruno Creek and S. Creek; negligible to minor effects to flow in Salmon River (depending on flow) due to cessation of removal of water for mine processes	Same as Alternative M2

Indicator	Alternative M1	Alternative M2	Alternative M3
WILDLIFE RESOURCES			
Area of disturbance to high value wildlife habitat	No change to existing conditions	Decrease of 413 acres of habitat with long-term, negligible to minor effect on sensitive wildlife species; long-term, minor effect on wide-ranging species; short-term, minor effect to winter range; negligible effect on migration Unintentional take, occurring when active migratory bird or raptor nests are either not found during surveys (i.e., disturbed unintentionally), or cannot be avoided, would be a short-term, minor effect and would not have any measurable effects on migratory bird populations.	Decrease of 647 acres of habitat with long-term, negligible to minor effect on sensitive wildlife species; long-term, minor effect on wide-ranging species; short-term, minor effect to winter range; negligible effect on migration Unintentional take, occurring when active migratory bird or raptor nests are either not found during surveys (i.e., disturbed unintentionally), or cannot be avoided, would be a short-term, minor effect and would not have any measurable effects on migratory bird populations.
Water quantity/quality effects on wildlife	Negligible effects from changes to water quantity; negligible effect to birds from ingestion of pit water	Negligible effects from changes to water quality; negligible effects to birds from ingestion of pit water	Same as Alternative M2
Noise disturbance	No change to existing conditions	Negligible (temporary) effect during construction of WRSFs	Same as Alternative M2
Wildlife mortality from traffic (road kill)	No change to existing conditions	No effect on existing road mortality, but 9 additional years of effect of mine traffic on road mortality	Same as Alternative M2
FISH AND AQUATIC RESOURCES			
Aquatic habitat	Negligible effect to existing conditions	Negligible effect to aquatic habitat in Salmon River; long-term, moderate effect to aquatic habitat in Thompson Creek and S. Creek	Same as Alternative M2

Indicator	Alternative M1	Alternative M2	Alternative M3
Fish populations	Negligible effect to existing conditions	Negligible effect to fish populations in Salmon River; long-term, moderate effect to aquatic habitat in Thompson Creek; long-term, minor to moderate effects to fish populations in S. Creek	Same as Alternative M2
Bioaccumulation	Negligible effect to existing conditions	Negligible chance of bioaccumulation of selenium in Thompson Creek	Same as Alternative M2
Macroinvertebrate organisms	Negligible (selenium bioaccumulation) to minor (reduced overall taxa richness) effects on macroinvertebrate organisms	Minor effects to Thompson Creek and S. Creek macroinvertebrate organisms for the best estimates; moderate effects for the upper estimates	Same as Alternative M2
WETLANDS, FLOODPLAINS, AND RIPARIAN AREAS			
Area of wetlands	No change to existing conditions	Fill or burial of 3.39 acres of jurisdictional wetlands (0.43 acre filled by Phase 8, 2.96 acres filled by reclamation); mitigation would result in no net effect	Fill or burial of 3.44 acres of jurisdictional wetlands (0.48 acre filled by Phase 8, 2.96 acres filled by reclamation); mitigation would result in no net effect
Length of stream channel	No change to existing conditions	10,641 feet (10 % of the stream channel) of WUS[5] filled (4,781 feet filled by Phase 8, 5,860 feet filled by reclamation); mitigation would result in no net effect	16,247 feet (50 % of the stream channel) of WUS filled (10,387 feet filled by Phase 8, 5,860 feet filled by reclamation); mitigation would result in no net effect
AIR QUALITY, NOISE, AND CLIMATE CHANGE			
Quantities of air pollutants	No change to existing conditions	No effect to existing quantity of air pollutants, but the existing quantity of air pollutants related to the mine would persist for an additional 9 years	Same as Alternative M2
Noise levels	No change to existing conditions	No effect to existing noise levels but the current noise levels related to the mine would persist for another 9 years	Same as Alternative M2

Indicator	Alternative M1	Alternative M2	Alternative M3
Climate change	No change to existing conditions	No effect to climate change and no effect of climate change to the project	No effect to climate change and no effect of climate change to the project
VISUAL (AESTHETIC) RESOURCES			
VQO and VRM classification	No change to existing conditions	The visual disturbance would meet the current visual classifications at all KOPs[6] except KOP 6; the Pat Hughes WRSF would not meet the VRM Class II objective (long-term, moderate to major effect)	The visual disturbance would meet the current visual classifications at all KOPs except KOP 6 and KOP 2; neither the Pat Hughes nor No Name WRSF would meet the VRM Class II objective (long-term, moderate to major effect)
LAND USE AND RECREATION			
Recreational access	No change to existing conditions	Negligible effect to recreational access	Negligible effect to recreational access
ROS[7] classification	No change to existing conditions	No change to ROS classification	No change to ROS classification
Special Designations	No change to existing conditions	Negligible effect to Challis ERMA	Negligible effect to Challis ERMA
SOCIOECONOMIC FACTORS			
Local economy	No change to existing conditions	No change to the current local economy, except the economic effects of the mine on the local economy would extend an additional 9 years	Same as Alternative M2
Molybdenum supply and prices	No change to existing conditions	No effect to current molybdenum supply or prices, except the effects of the mine on supply and prices would extend an additional 9 years	Same as Alternative M2
Financial risk to agencies and taxpayers	Financial risk would be mitigated by financial guarantees	Financial risk would be mitigated by financial guarantees	Financial risk would be mitigated by financial guarantees

Indicator	Alternative M1	Alternative M2	Alternative M3
TRIBAL TREATY RIGHTS AND INTERESTS			
Area of unoccupied Federal land	No change to existing conditions	< 1 % decrease (minor, permanent, adverse)	Same as Alternative M2
Cultural resource sites	No change to existing conditions	Site 10CR758 (eligible for the NRHP) would be partially inundated by the expansion of the TSF (long-term, adverse effect)	Same as Alternative M2
Effects to natural resources utilized by tribes	Summarized in the sections for the other resources	Summarized in the sections for the other resources	Summarized in the sections for the other resources
CULTURAL RESOURCES			
Cultural resource sites	No change to existing conditions	Site 10CR758 (eligible for the NRHP) would be partially inundated by the expansion of the TSF (long-term, adverse effect)	Same as Alternative M2.
TRANSPORTATION, ACCESS, AND PUBLIC SAFETY			
Molybdenum spills due to vehicle accidents	No change to existing conditions	No effect to current threat of spills, but the current potential for spills would extend additional 9 years	Same as Alternative M2
HAZARDOUS MATERIALS AND SOLID WASTE			
Threat of releases of hazardous materials and petroleum products	No change to existing conditions	No effect to threat of releases, but the current potential for releases would extend additional 9 years	Same as Alternative M2

[1] Threatened, Endangered, Proposed, Candidate, and Sensitive (special status)
[2] mbf = 1,000 board feet
[3] animal unit months (AUMs)
[4] water quality standards (WQSs)
[5] waters of the US (WUS)
[6] key observation point (KOP)
[7] recreational opportunity spectrum (ROS)

2.1.6. Monitoring and Mitigation

The consolidated environmental monitoring program (part of the MMPO) (TCMC 2008a), describes the diverse elements of the environmental monitoring conducted annually by and for TCMC. The purpose of the monitoring program is to document compliance, identify potential noncompliance, and detect favorable and unfavorable trends in environmental conditions. The scope of this program includes ground and surface water sampling, biological monitoring, stream sediment monitoring, water discharge permit compliance monitoring, embankment structural and stability monitoring, mine waste monitoring, action response requirements for water quality management, a formal quality assurance program, and formal reporting procedures for environmental monitoring (TCMC 2008a). Adaptive management strategies (Section 2.1.1.9.) would allow for adjustment of operating procedures, mitigation measures, and/or monitoring in response to key resource concerns identified through monitoring.

As part of the environmental effects analysis, the agencies have identified certain mitigation measures that could be applied to reduce the environmental effects of the MMPO alternatives. These mitigations are described in Section 4.21.

2.1.7. MMPO Alternatives Considered but Eliminated From Further Analysis

The range of reasonable alternatives for mining, and especially for an existing mine, is inherently limited due to the fixed location of rare ore bodies, and the world-wide competition which typically requires mining by the most economical method for a mine to be economically feasible. The range of alternatives is even more limited when evaluating an existing mine, as is evident by the summaries of some of the alternatives considered but eliminated from further analysis for the project.

Locating Mining and Milling Facilities Elsewhere

There is no technologically feasible alternative for relocating the open pit because mining must occur at the ore body, and the mill facilities must be as near the ore body as possible for obvious economic reasons. Furthermore, it would be cost prohibitive ($100s million) to relocate the mill facilities. In addition, the WRSFs, TSF, and mill were sited and constructed in their current locations after the 1980 EIS for the mine evaluated a wide range of alternatives and selected the current locations as the optimum alternative. There is no environmental reason to move the facilities elsewhere, and relocating the mill would cause substantial surface disturbance at the new location.

Underground Mining

It would not be feasible technologically or economically at this point in the mine life to mine the Phase 8 ore body by underground methods, store waste rock or tailings underground, or to relocate other support facilities underground. Underground mining is technologically and economically preferable when the ore body is too deep or inaccessible for open pit mining and removal of the overburden for an open pit is too expensive. This is not the case for the TCM where most of the overburden required to mine the Phase 8 ore will already have been removed by previous mining phases, so only the incremental overburden required to expose the Phase 8 ore requires removal. Additionally, underground mining is typically applicable only in cases

where the grade of the ore is relatively high (~ 0.3 % molybdenum), and not for lower grade ore bodies (~ 0.08 % molybdenum), such as the Phase 8 ore at the mine.

Using August 2012 commercial mine cost data and cost models (InfoMine 2012a), the least expensive underground mining technique is block caving. If such technique could be applied to the Thompson Creek ore deposit, the typical production of 30,000 tons per day of ore would require a capital cost of approximately $115,000,000 for adit entry or $165,000,000 for shaft entry. The block caving operating cost would be approximately $8.15 per ton of ore for adit entry or $9.50 per ton of ore for shaft entry. The life-of-mine open pit operating cost is $1.42 per ton of material (overburden and ore) (Marek and Lechner 2011). Therefore, it would not be economically reasonable at current or realistic future molybdenum prices to convert the mine from surface to underground block caving operations as this would involve a capital cost of more than $100,000,000 and an operating cost at least $10,000,000 per year more than that of the current surface mining operations.

Concurrently Backfilling Open Pit

Concurrently backfilling portions of the open pit with waste rock or tailings would reduce the volume of material placed in the WRSFs or the TSF, incrementally reducing their height and their areas, compared to that under Alternative M2. However, the pit walls are uniformly steep and the ore body always occurs on the sides and floor of the pit. Therefore, there is no place in the pit to store waste material during mining, i.e., placing waste material in any portion of the pit would prevent the extraction of the underlying ore body. In addition, there would be substantial physical safety hazards from trying to simultaneously mine and backfill in the close confines of the pit floor. Concurrent backfilling is generally feasible only when mining a series of pits sequentially such that the waste material from an active pit may be placed into a previously mined pit.

Backfilling the Open Pit

Relocating waste rock from the WRSFs (or tailings from the TSF) back to the open pit after molybdenum production ceases would reduce the size of the WRSFs (or the TSF), and reduce the depth and/or area of the open pit. To be meaningful, the pit would need to be filled or WRSFs would need to be substantially removed, i.e., operating the mine in reverse. The cost to backfill the pit at the end of Phase 7 and Phase 8 would be $318 million and $655 million, respectively (TCMC 2012b). Such costs are not economically feasible, e.g., the Phase 8 cost would be greater than the net present value of the mine at a 10 percent discount rate and a molybdenum price of $12.50 per pound (Marek and Lechner 2011). Also, filling the pit with waste rock would cause uncertain environmental effects (e.g., changes in the hydrologic balance, pore water chemistry of the waste rock filling the pit, etc.) with less control of the waste rock. In addition, backfilling the pit would preclude mining low-grade resources that might become economic at some point in the future – pits are regularly restarted after decades of inactivity.

Basin Creek Waste Rock Storage Facility

The Basin Creek drainage, the next drainage north of the Buckskin drainage, was considered for construction of a WRSF. Under this alternative the height increase and lateral expansion that would occur in the WRSFs under all of the MMPO alternatives would be reduced. However, placing waste rock in the Basin Creek area would involve a long uphill haul from the open pit

that would be substantially more expensive than adding this volume of waste rock to the WRSFs involved in any of the MMPO alternatives. The surface disturbance of a new WRSF in Basin Creek would also be greater than the new surface disturbance of the WRSFs in any of the MMPO alternatives. In addition, a new WRSF in Basin Creek would also affect a new watershed that would not be affected under any of the MMPO alternatives.

Full Realignment of the TSF Embankment with Upstream Raise

Raising the height of the impoundment for the Phase 8 tailings storage requires increasing the height of the embankment to an elevation of 7,742 feet, which is greater than a topographic low spot on the ridge at the northeast abutment. Under the full re-alignment alternative, a new centerline embankment would be constructed across the entire width and on top of the existing impoundment upstream of the embankment. The result would be an impoundment on top of an impoundment, with the upper impoundment shifted upstream of the existing impoundment producing a stair-step pattern. Such "upstream" construction would eliminate the elevation constraints at the northeast abutment.

Construction of upstream TSF impoundments is widely practiced in the global mining industry but requires sufficient consideration of stability, particularly under seismic loadings, to ensure that the upstream embankment has suitable foundation strength to ensure long-term stability. Idaho regulations (IDAPA 37.03.05 Item 045.01.b) prohibit upstream construction of TSF impoundments unless the embankment and tailings density is 60 percent or greater during seismic loading. The tailings facility engineers for TCMC do not believe the density of the embankment and tailings at the mine during seismic loading could be reasonably assured to be less than 60 percent (Golder 2008).

New TSF Downstream of Existing TSF

Under this alternative, a new centerline raise TSF would be developed downstream of the existing TSF near the existing SRD. The embankment of the new TSF would have a crest elevation of 7,174 feet and would be combined with a raise of the existing TSF to 7,726 feet. Part of the Phase 8 tailings would be deposited in the new TSF, and the balance of the tailings would be stored behind the existing TSF (with a raised embankment).

The construction of an entirely new TSF would require consideration of all the design and construction details for foundation preparation, embankment drainage, embankment construction, and monitoring of the existing embankment. The existing SRD would need to be eliminated and a new one constructed downstream of the new TSF. The embankment drainage facilities for the existing TSF would need to be modified and integrated into the new TSF. There would be additional disturbance to the Bruno Creek watershed downstream of the existing TSF along with an incremental raise, and concurrent watershed disturbance upstream of the existing TSF.

Disposing of Mill Tailings or Mine Overburden through Off-site Utilization

An alternative was considered in which tailings sand (with the pyrite removed, also known as tailings slimes) and/or waste rock would be shipped off-site for commercial uses, which would reduce the ultimate size of the tailings and WRSFs. However, there is no local market for any meaningful amounts of such material, and the low unit value of the material precludes shipping

meaningful amounts of the material to other more distant markets. There is no known commercial use of tailings slimes, there is no local market for any meaningful amounts of such material, and the low unit value of the material precludes shipping meaningful amounts of the material to other markets. Therefore, this alternative was not economically feasible.

Waste Rock Buttress of Tailings Storage Facility Embankment

The agencies asked if TCMC had considered using some of the Type 1 waste rock produced during Phase 8 to help buttress the TSF embankment. The rock toe embankment at the base of the TSF embankment would be raised to 6,960 feet during the construction of the Phase 8 TSF embankment; however, the downstream sand slope of the embankment would still be steepened to 2.75 H:1 V from the current 3 H:1 V. To reduce the sand volume required to raise the embankment to the required Phase 8 elevation, TCMC could use Phase 8 Type 1 waste rock to further raise or otherwise buttress the rock toe embankment. However, all of the Type 1 waste rock would be necessary for reclamation of the WRSFs and, therefore there would not be sufficient Type 1 waste rock to buttress the embankment. In addition, the amount of sand produced from cycloning the tailings would be insufficient to fill in the area behind an enlarged rock buttress. Furthermore, a new road would be necessary to haul waste rock to the base of the embankment, which would incur substantially higher capital and operating costs and require disturbing substantial new area. Moreover, the review of the stability of the TSF (e.g., KP 2013) indicates no need for additional buttressing.

Artificial Liners for the WRSFs or TSF

The agencies considered including artificial (e.g., geosynthetic clay) liners near the surfaces of the WRSFs and the TSF. However, such liners would have considerable costs (millions of dollars), would be subject to damage in the long term, and would not affect water quality due to the active water treatment that would occur.

2.2. Land Disposal Alternatives

The BLM objectives used to guide the land disposal alternatives include the following:

- Ensure compliance with the BLM Challis Field Office RMP;
- Provide for efficient administration of lands by the BLM, e.g., increase block ownership and not result in small isolated areas ("islands") or narrow strips of BLM land; and
- Satisfy the equal value and public interest requirement of the FLPMA.

It is important to note that the boundaries and conditions of the selected[8] and offered lands described in the land disposal alternatives are necessarily approximate. However, the BLM believes the selected and offered lands have equivalent fair market value, and that under all land

[8] "selected" and "offered" are used from the perspective of the proponent, i.e., the selected land is the BLM land desired by TCMC

disposal alternatives there would be sufficient fair market value of the selected and offered lands to allow for adjustments to the boundaries and/or conditions of the lands for value equalization, acceptable title, or other administrative concerns.

Equal Value

The FLPMA requires that lands being exchanged be of equal (fair market monetary) value. To achieve this, all reasonable efforts must be made to equalize the value by adding or excluding lands and/or by making a cash equalization payment, up to 25 percent of the value of the public lands leaving Federal ownership (43 CFR 2201.6). This requirement ensures that the exchange is fair, despite the inevitable difference in the areas of the offered and selected lands, since not all land is worth the same dollar amount per acre.

Public Interest, Land Management, and Resource Values

The FLPMA requires that the public interest would be well served by a land exchange. In considering whether an exchange is in the public interest, the FLPMA directs the Secretary to "give full consideration to better Federal land management and the needs of State and local people, including needs for lands for the economy, community expansion, recreation, areas, food, fiber, minerals, and fish and wildlife..." The Secretary must also find "that the values and the objectives which Federal lands or interests to be conveyed may serve if retained in Federal ownership are not more than the values of the non-Federal lands or interests and the public objectives they could serve if acquired" (FLPMA Section 206(a)).

Mutual Agreement on Configuration of Exchange Lands

Since Federal land exchanges are discretionary, both the BLM and the exchange applicant must agree to the configuration of the selected and offered lands. Therefore, the Interior Board of Land Appeals has determined that "in conducting an environmental review of a proposal to exchange public for private land, BLM need not consider the alternative of conveying other land if it is not desired by the private party involved in the exchange and conveyance of such land would not satisfy the purpose of the exchange" (124 IBLA 44 [1992]). The land disposal alternatives are restricted to those configurations of selected and offered lands that are mutually acceptable to the exchange proponent and the BLM, and thus would satisfy the purposes of both TCMC in proposing the exchange and the BLM in responding to the land exchange proposal.

2.2.1. Alternative L1 – No Action

The BLM would not approve the land exchange proposal or any of the other land disposal alternatives, and would not amend the Challis RMP to identify the selected land as suitable for disposal under the FLPMA (Section 1.4). There would therefore be no change to the current land status: the Broken Wing Ranch (813 acres) and Garden Creek property (82 acres) would remain privately owned, and the selected land (~ 5,100 acres) would remain as BLM land (Figure 1.2-1., Figure 1.3-1). Since none of the MMPO alternatives are affected by any of the land disposal alternatives, under Alternative L1 the mine would continue operations on a combination of private, BLM, and NFS land as described in MMPO Alternative M1, M2, or M3 depending upon the agency decisions for the MMPO alternatives (Section 2.1).

TCMC could sell the offered lands to another party. The Broken Wing Ranch would probably continue to be used as private ranch (irrigated agriculture and cattle) with no public access to the property. Commercial sales of quartzite talus would likely continue, and some property adjacent to the Salmon River or along Lyon Creek could be sold and developed for residential/recreational use.

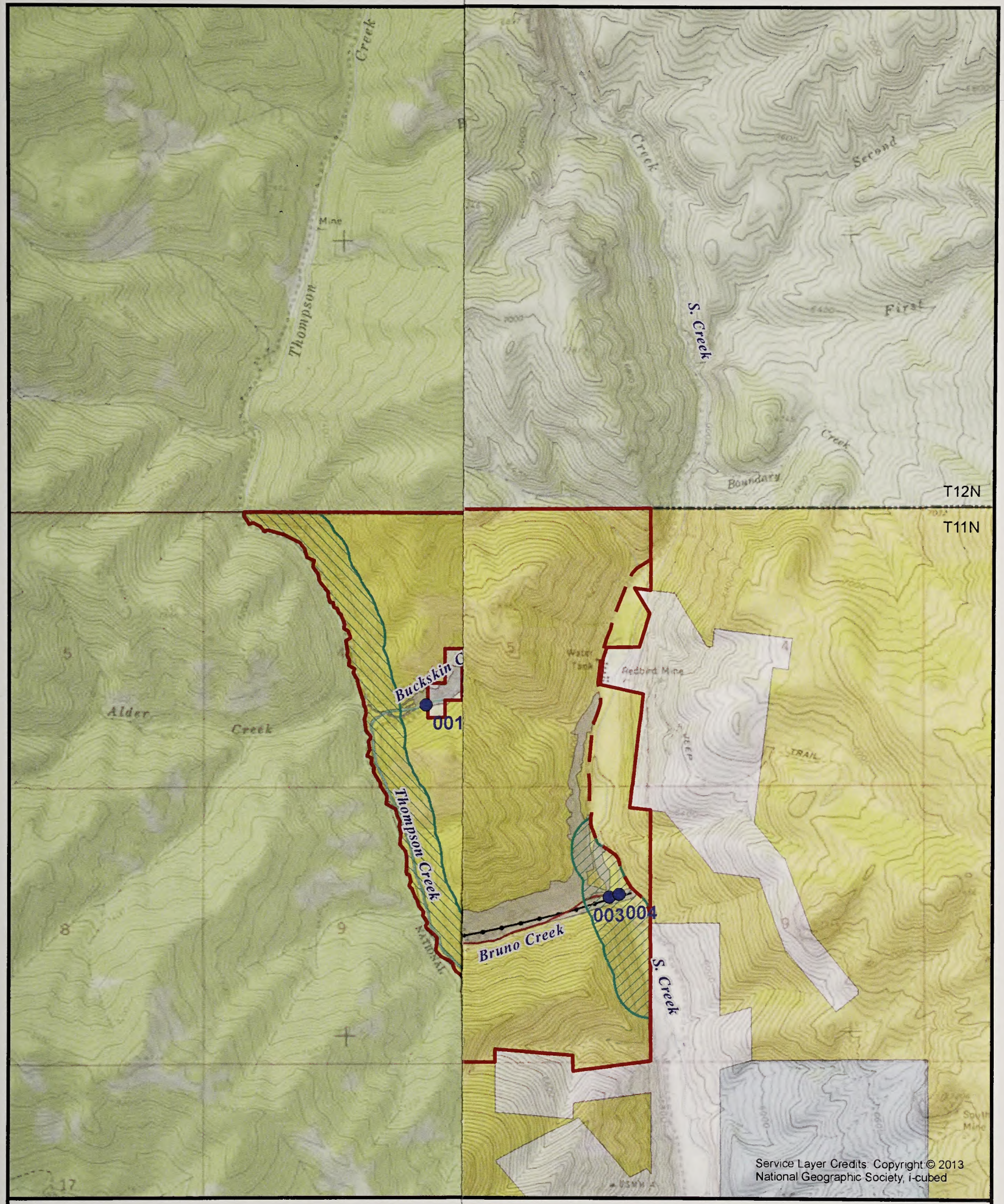
2.2.2. Alternative L2 and Alternative L2-B – Land Exchange Proposal

The BLM would amend the Challis RMP to identify the selected land as suitable for disposal under the FLPMA, and would approve the land exchange proposal. These actions would be made pursuant to all other applicable laws (e.g., Section 202 of the FLPMA for land use plans and Section 206 of the FLPMA for land exchanges), regulations (e.g., 43 CFR 1600 for land use plans and 43 CFR 2200 for land exchanges), and policy (e.g., the BLM Land Use Planning Handbook [BLM 2005a] and BLM Land Exchange Handbook [BLM 2005b]). TCMC would thus acquire a tract of BLM (selected) land, including both surface and mineral estates on up to approximately 5,100 acres, at the mine site. The US would acquire two tracts of privately owned (offered) land, including both surface and mineral estates on up to approximately 900 acres that would be administered by the BLM. The selected land comprises all Federal land in Sections 1 to 4, 9 to 12, T. 11 N., R. 16 E. and Sections 5 to 8, T. 11 N., R. 17 E., B.M. in Custer County, Idaho (Figure 1.2-1., Figure 2.2-1).

However, as an example of the minor adjustments that might occur, the BLM would exclude the Federal land east of the centerline of S. Creek Road from the selected land. Therefore, the *selected land* hereafter refers to such reduced area ("modified east boundary," ~ 5,100 acres) (Figure 2.2-1., dashed red line).

The offered lands consist of two tracts owned by TCMC: the Broken Wing Ranch, 6 miles northeast of Clayton in Custer County, Idaho; and the Garden Creek property, 16 miles southeast of Pocatello in Bannock County, Idaho (Figure 2.2-2). Descriptions of the selected and offered lands and the reasonably foreseeable[9] uses of the lands are provided below. A description of provisions that would apply to all land disposal action alternatives is also provided below and in Section 2.2.7. Alternative L2-B is a sub-alternative to Alternative L2 specific to the Broken Wing Ranch (Section 2.2.2.2).

[9] For the purpose of this FEIS *reasonably foreseeable* is a few decades. Actions occurring 50 to 100 years in the future are highly uncertain and add unnecessary speculation to the analysis. Hence, Federal land use plans are for periods of 20 years, and long-range mine planning is typically limited to 20 to 40 years in the future. In the case of cumulative effects analysis (Chapter 5), reasonably foreseeable typically means only proposed projects.



Sciences.

Legend

- Alternative L2 selected land
- Modified east boundary
- Existing mining disturbance
- MMPO areas/Alternative M2
- Thompson Creek easement are
- S. Creek easement area
- Easement exclusion area
- NPDES outfall

Figure 2.2-1
Land Disposal Alternative L2 - Land exchange proposal, selected land
Thompson Creek Mine EIS

TCMC could sell the offered lands to another party. The Broken Wing Ranch would probably continue to be used as private ranch (irrigated agriculture and cattle) with no public access to the property. Commercial sales of quartzite talus would likely continue, and some property adjacent to the Salmon River or along Lyon Creek could be sold and developed for residential/recreational use.

2.2.2. Alternative L2 and Alternative L2-B – Land Exchange Proposal

The BLM would amend the Challis RMP to identify the selected land as suitable for disposal under the FLPMA, and would approve the land exchange proposal. These actions would be made pursuant to all other applicable laws (e.g., Section 202 of the FLPMA for land use plans and Section 206 of the FLPMA for land exchanges), regulations (e.g., 43 CFR 1600 for land use plans and 43 CFR 2200 for land exchanges), and policy (e.g., the BLM Land Use Planning Handbook [BLM 2005a] and BLM Land Exchange Handbook [BLM 2005b]). TCMC would thus acquire a tract of BLM (selected) land, including both surface and mineral estates on up to approximately 5,100 acres, at the mine site. The US would acquire two tracts of privately owned (offered) land, including both surface and mineral estates on up to approximately 900 acres that would be administered by the BLM. The selected land comprises all Federal land in Sections 1 to 4, 9 to 12, T. 11 N., R. 16 E. and Sections 5 to 8, T. 11 N., R. 17 E., B.M. in Custer County, Idaho (Figure 1.2-1., Figure 2.2-1).

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R16E R17E

T12N

T11N

Buckskin Waste Rock Storage Facility

Tailings Storage Facility

Open Pit

Shops/ Crusher/ Office

Pat Hughes Waste Rock Storage Facility

Mill

Cherry Creek Pump Station

001

002

003004

005 (Downstream to Thompson Creek and Salmon River Confluence)

Bruno Creek

Redbird Creek

Mill Creek

Buckskin Creek

Thompson Creek

No Name Creek

Pat Hughes Creek

Cherry Creek

S. Creek

Alder Creek

Service Layer Credits: Copyright © 2013 National Geographic Society, i-cubed

Legend

- Alternative L2 selected land
- Modified east boundary
- Existing mining disturbance
- MMPO areas/Alternative M2
- Thompson Creek easement area
- S. Creek easement area
- Easement exclusion area
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

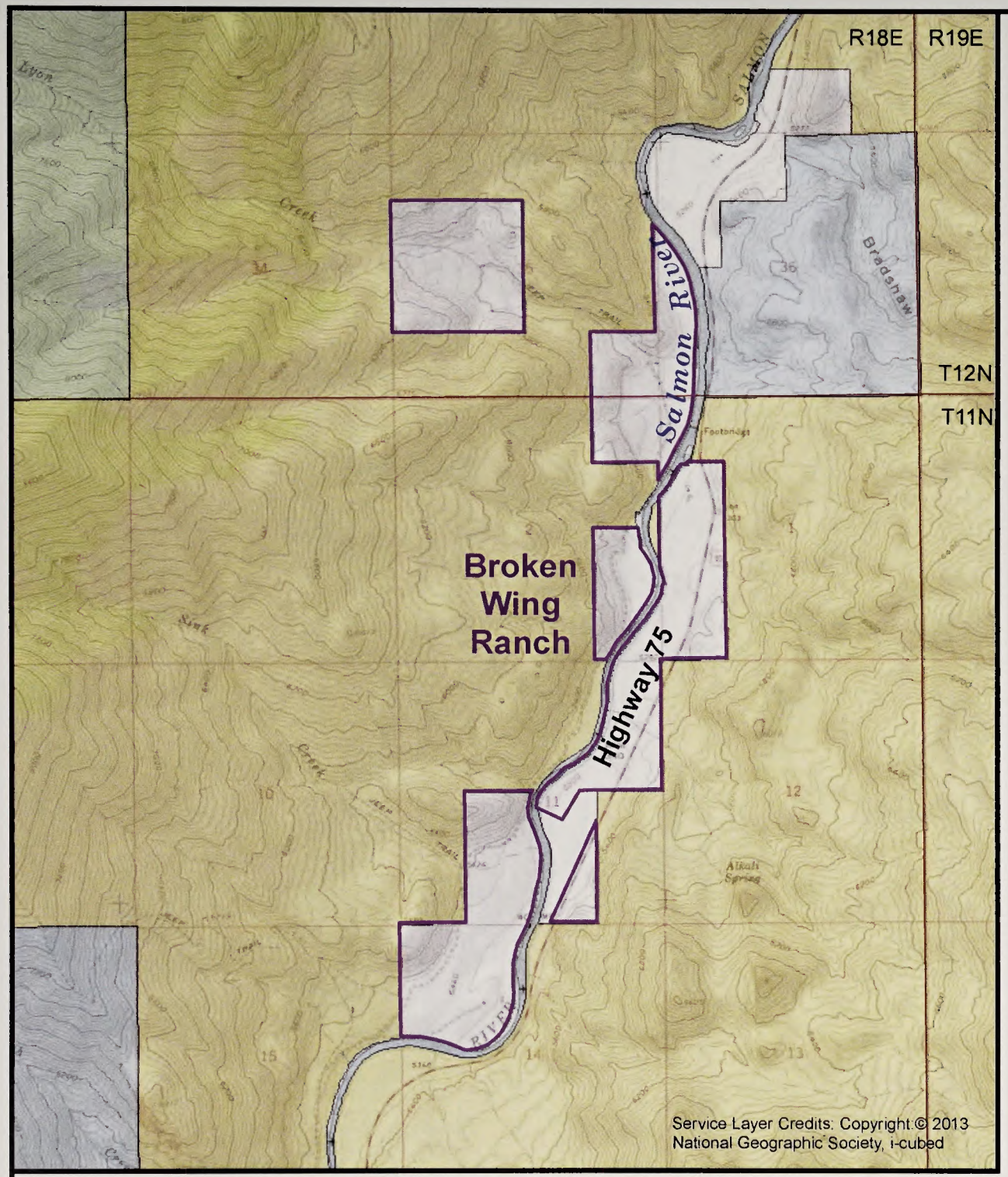
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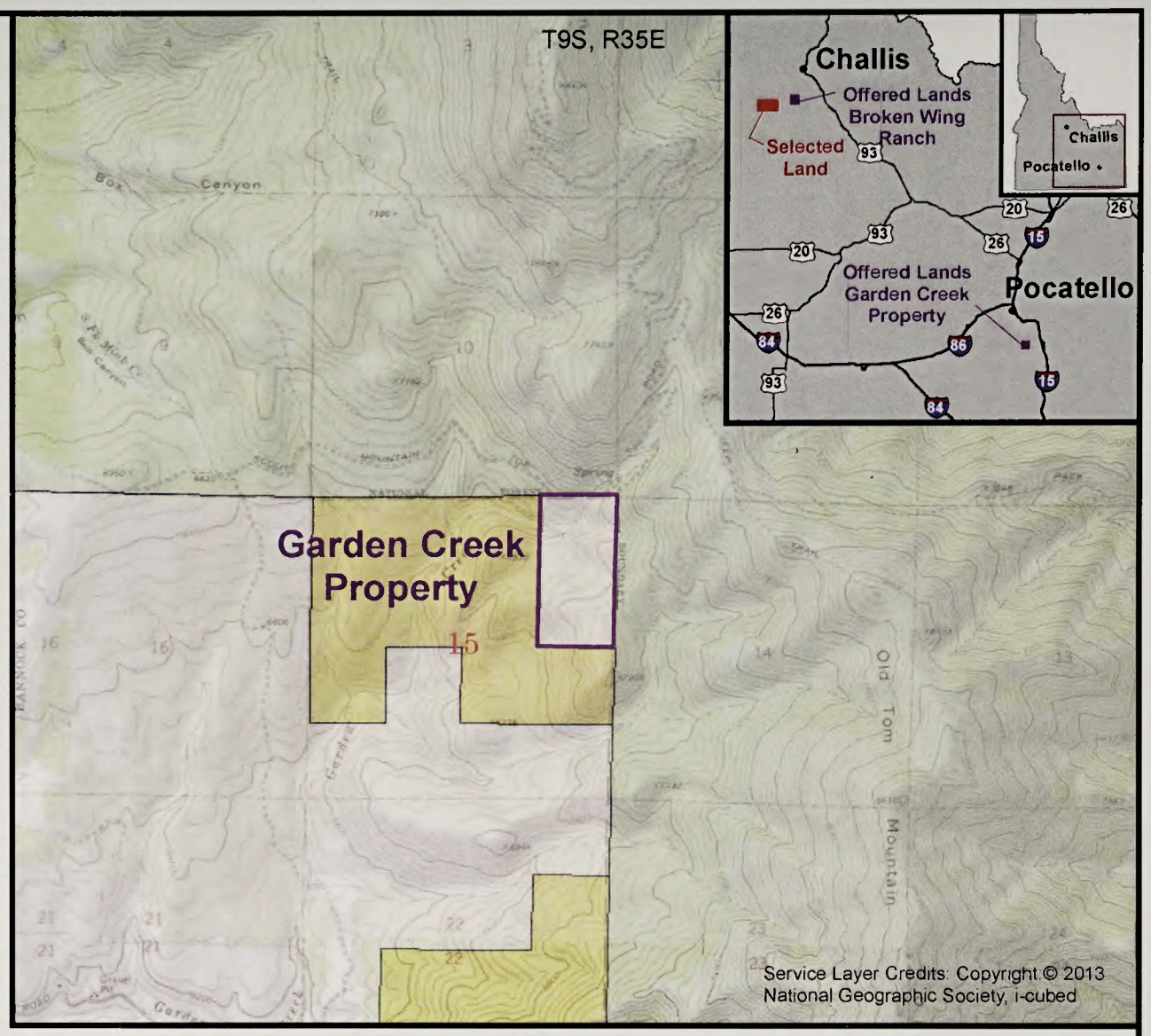
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No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.2-1
Land Disposal Alternative L2 - Land exchange proposal, selected land
Thompson Creek Mine EIS





Legend

- Offered lands

Land Ownership

- BLM
- Private
- State
- Forest Service

Offered lands from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background is USGS 1:100,000-scale metric Topographic Maps.
Coordinate system UTM Zone 11 NAD 83

N

1:48,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.2-2
Land Disposal Alternative L2 - Land exchange proposal, offered lands
Thompson Creek Mine EIS

2.2.2.1. Selected Land

The selected land (~ 5,100 acres) is either undeveloped, forested land (Photo 2.2-1., Photo 2.2-2.) or is already used for mining (Photo 2.2-3., Photo 2.2-4., Photo 2.2-5). All of the land is covered by mining claims owned by TCMC. Mining currently disturbs 451 acres of the selected land including a widely distributed network of sedimentation ponds, access roads, and power line and pipeline corridors (Figure 2.1-1., Table 2.1-3). The additional disturbance of the selected land under the MMPO alternatives would be 200.1 acres under Alternative M2, and 417.9 acres under Alternative M3. There would not be any additional disturbance of the selected land under Alternative M1. If the BLM were to no longer administer a portion of the MPO for the mine (Section 1.4.), the interagency taskforce (less the BLM) would continue to inspect the mine along with separate inspections by the other Federal and State agencies, including two land management agencies (Forest Service and IDL).

TCMC has stated that it has no current intention to use any of the selected land for mining, including mineral exploration, apart from the activities identified in the MMPO alternatives (Section 2.1). That is, TCMC would not mine differently under any of the MMPO alternatives if the selected land were owned by TCMC or if the selected land continued to be Federal land. In addition, internal and public scoping and a mineral potential report (Gardner 2008) have not identified any mining activities that would reasonably be expected to occur on the selected land, apart from those identified in the MMPO alternatives.

TCMC does not have post-reclamation development plans for the selected land should TCMC acquire it. In addition, water treatment activities on some of the land could occur many decades after mining ceases in 2025. Therefore, speculation concerning post-reclamation uses of the land by TCMC might include retaining ownership or sale to a private party, or perhaps donation to Custer County or a university; the land could also be burned by wildfire. Regardless, what might happen to the selected land upon completion of mine reclamation is not reasonably foreseeable and too speculative to evaluate in detail in this FEIS.

2.2.2.2. Offered Lands – Broken Wing Ranch

The Broken Wing Ranch consists of 813 acres of irrigated agricultural fields, rangeland, ranch structures, and a historic homestead in Custer County. The ranch includes 4.4 miles of Salmon River frontage as well as various streams including Lyon Creek (Photo 2.2-6. through Photo 2.2-11).

Alternative L2

The ranch would be managed generally according to the recommendations of the BLM Idaho Falls District RAC (BLM 2009b), which categorizes the ranch into nine management parcels with specific management recommendations for each parcel. However, because the management parcels do not all correspond to surveyed areas of land, for the purposes of this FEIS the parcels are assigned to seven surveyed subparcels (BWR-1 through BWR-7) (Figure 2.2-3., Table 2.2-1).



Photo 2.2-1. Selected land from Bruno Creek access road, view to southwest.



Photo 2.2-2. Selected land from lower Pat Hughes drainage, view to northwest.



Photo 2.2-3. Selected land south of the Pat Hughes WRSF, view to north.



Photo 2.2-4. Selected land surrounding Bruno Creek access road, view to west.



Photo 2.2-5. Selected land below base of TSF impoundment.
Temporary tailings containment ponds and timbered ridge in photo center, view to southeast.

The management of the ranch would include standard agricultural and ranching activities (e.g., plowing, seeding, fertilizing, hay cutting/baling, weed eradication); installing and maintaining fish screens; improving instream and other riparian habitat; hazard tree removal; maintaining vehicles and equipment; and storing ranch supplies outside of riparian habitat conservation areas. Alternative L2 would also include maintaining buildings, lighting, roads, culverts, ditches, berms, irrigation equipment, etc.; and relocating roads and fords (e.g., moving the section of road north from Lyon Creek Bridge further from the Salmon River to the west side of the adjacent fence; moving a section of road away from the northern pivot).

Alternative L2 would modify irrigation/water management and agricultural practices (e.g., 360 degree pivot irrigation instead of not watering small areas of adjacent BLM land; changing crop types; installing culverts; armoring fords; installing a bridge over the Lyon Creek ford; constructing ditches and berms to adjust surface runoff/flood irrigation; converting flood, hand line, wheel line, and pivot irrigation from one type to another); maintain, relocate, and construct fences (e.g., subdividing fields, excluding cattle from the Salmon River and Lyon Creek, relocating water gaps); and construct or relocate small structures such as livestock handing facilities, pump houses, wells, stock watering facilities, etc. Permanent new or reconstructed fences would be wildlife friendly according to the standards of BLM (1989). Non-motorized trails could also be developed on the ranch along sections of the Salmon River and to access interpretive sites such as the Maraffio homestead. Kiosks and signs for interpretation or management purposes could also be installed on the ranch. In addition, the BLM has developed a conceptual restoration plan for the lower 1,850 feet of Lyon Creek to address removal of an on-channel impoundment (Lyon Creek pond), consolidation of four stream crossings, as well as improved fish passage, fish habitat, channel stability, and riparian vegetation. Final designs

would be made, project funding would be sought, and the BLM would implement the plan if the US acquires that portion of the ranch.

The BLM policy is to avoid obtaining structures not necessary for the BLM mission. Therefore, prior to the land exchange, TCMC may donate to Custer County the Lyon Creek Bridge, as well as the Lyon Creek and Sink Creek ranch houses/outbuildings. Alternatively, prior to the land exchange, TCMC may sell the Lyon Creek ranch house/outbuildings to a private party and/or remove the Sink Creek ranch house, i.e., no Sink Creek parcel donated to the county. The donation or sale of the Lyon Creek and Sink Creek structures would include 2.5 acres (county minimum parcel size) of land around each house, and appropriate easements for access. For liability reasons, Custer County would not allow public use of the bridge. However, the BLM would pursue administrative access for the BLM and State agencies to use the bridge (the BLM would have administrative access under the FLPMA to all BLM land, despite any public restrictions), and will ask Custer County to consider granting the public non-motorized access to cross the bridge. The BLM would grant administrative access to the ranch to State agencies, e.g., the use of motorized vehicles on Lyon Creek Road. In any case, the historical structures on the ranch would be acquired by the BLM.

Access to the ranch by public vehicles from SH 75 would be by traveling 2.0 miles north on Poverty Flat Road, 1.0 mile north on Sink Creek Road, and 0.7 mile south on Lower Sink Creek Road to the main ranch road on the west side of the Salmon River. The main ranch road leads 2.4 miles to the Lyon Creek ranch house (Figure 2.2-3). Several areas along the ranch road would be widened for parking, and a few sections of the road would be re-aligned (including reducing the grade in one or two places) so that vehicles would avoid the irrigated fields (e.g., 1,200 feet of road would be bladed across the flat ground at the base of the hill around the north edge of the southernmost circular pivot) and would be able to easily pass pivots, hay storage areas, fence lines, etc.

The BLM would make the ranch available for grazing (~ 800 acres of irrigated fields and rangeland), and would authorize grazing for 27 AUMs in the Lyon Creek "Graham Field" meadow. The meadow would be grazed according to an existing conservation plan for the ranch sponsored by Custer Soil and Water Conservation District: up to 200 cow/calf pairs for 3 to 5 days (0.62 AUMs/acre, WSLM 2012). The season of use would be either 1) during 3 to 5 days during the first week in May (cow/calf pairs), or 2) during 3 to 5 days during mid- to late-October or the first week in November (cows only). For the rest of the irrigated fields on the ranch, the potential stocking rate would be 3,040 AUMs (Table 2.2-1., Table 2.2-2).[10] However, at times the BLM would not graze BWR-7. Therefore, based on past grazing, the BLM would authorize approximately 2,400 AUMs[11] (79 % of the available forage from the irrigated fields), or approximately 2,280 AUMs[12] during the times BWR-7 was not grazed. The season of use would be from September 15 to May 15 with up to 300 cows. Grazing would incorporate terms and conditions to ensure conformance with 43 CFR 4180 (fundamentals of rangeland health) and consistency with the Challis RMP.

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[10] 813 acres on ranch subparcels; 424 acres cultivated; 389 acres rangeland - 20 acres disturbed - 6.8 acres riparian shrubland = 362 acres rangeland; cultivated land on each subparcel x ~ AUMs/acre/subparcel = 3,038 AUMs

[11] 300 cows x 243 days / 30.41666 days/month = 2,396.7 AUMs

[12] The AUMs typically made available from BWR-7 are 54 acres x 0.32 irrigated x 7 AUMs/acre = 121 AUMs.

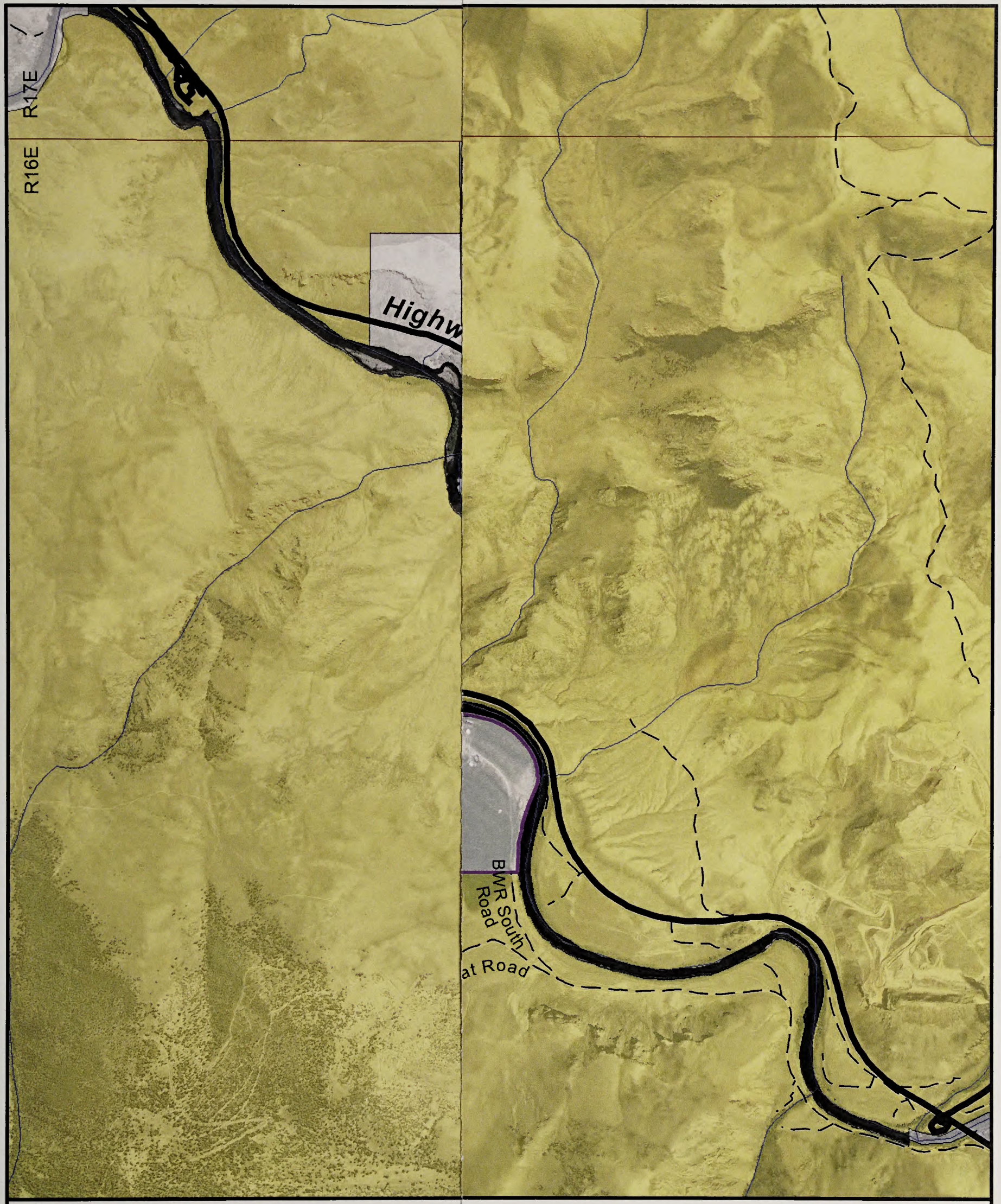
The non-motorized access in the Lyon Creek drainage would begin at or near the Lyon Creek ford by the Lyon Creek ranch house. Firearm discharge safety zones would be established around the two ranch houses, but hunting and shooting would otherwise (generally) be allowed in the same manner as is allowed on other Federal lands. However, the public would not be allowed in the cultivated fields during the growing season (e.g., mid-April through mid-October) to avoid damage to crops. The dilapidated trailer on the east side of the Salmon River would be demolished and removed, and the driveway and former trailer site would be used for parking and river access.



Photo 2.2-6. Broken Wing Ranch, Salmon River frontage, view to south.



Photo 2.2-7. Broken Wing Ranch, Salmon River frontage, view to east.



Sciences.

Legend

- Broken Wing Ranch
- Main Broken Wing Ranch access
- Main Broken Wing Ranch access (not yet constructed)
- 2WD road (Highway 75)
- Primitive road
- Stream

Figure 2.2-3
Land disposal alternatives - Broken Wing Ranch NEPA subparcels
Thompson Creek Mine EIS

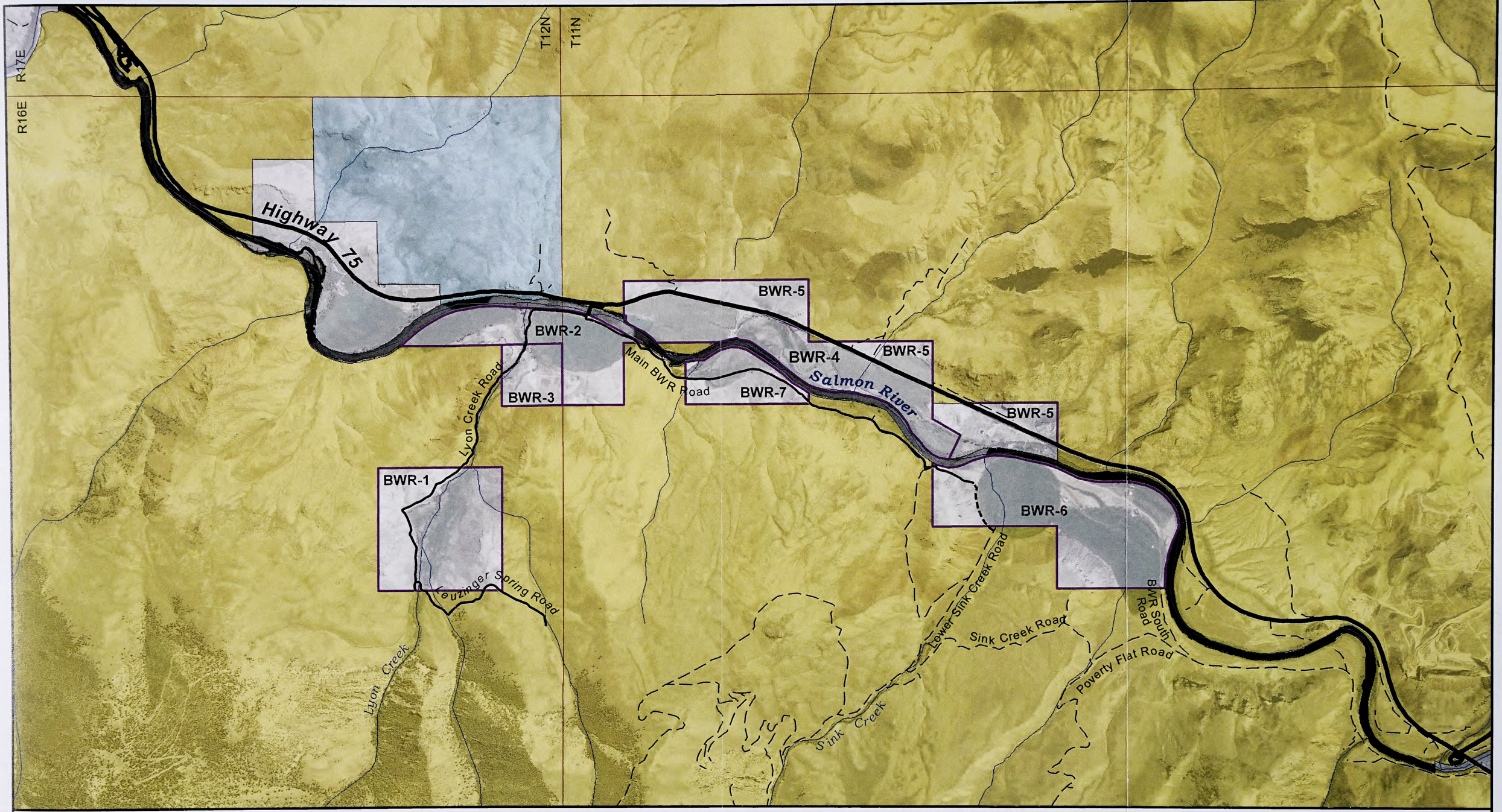
The non-motorized access in the Lyon Creek drainage would begin at or near the Lyon Creek ford by the Lyon Creek ranch house. Firearm discharge safety zones would be established around the two ranch houses, but hunting and shooting would otherwise (generally) be allowed in the same manner as is allowed on other Federal lands. However, the public would not be allowed in the cultivated fields during the growing season (e.g., mid-April through mid-October) to avoid damage to crops. The dilapidated trailer on the east side of the Salmon River would be demolished and removed, and the driveway and former trailer site would be used for parking and river access.



Photo 2.2-6. Broken Wing Ranch, Salmon River frontage, view to south.



Photo 2.2-7. Broken Wing Ranch, Salmon River frontage, view to east.



Legend

- Broken Wing Ranch
- Main Broken Wing Ranch access
- Main Broken Wing Ranch access (not yet constructed)
- 2WD road (Highway 75)
- Primitive road
- Stream

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:24,000 4,000
Feet

0 1
Kilometers

NEPA parcels for the Broken Wing Ranch from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Aerial image NAIP 2009
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.2-3
Land disposal alternatives - Broken Wing Ranch NEPA subparcels
Thompson Creek Mine EIS



Photo 2.2-8. Broken Wing Ranch, Lyon Creek, view to south.



Photo 2.2-9. Broken Wing Ranch, view to east from upper Lyon Creek meadow.



Photo 2.2-10. Broken Wing Ranch, Lyon Creek meadow, view to south.



Photo 2.2-11. Broken Wing Ranch, upper Lyon Creek meadow.
BLM land north of meadow. View to west.

Table 2.2-1. Broken Wing Ranch RAC parcels and subparcels.

Subparcel ID	RAC Parcel ID(s)	(acres)	Current Land Use(s)	RAC Proposed Land Use
BWR-1	A	160	• apple orchard • grazing; no fences to separate the private land from adjacent BLM land, but the meadow ("Graham Field," 42.9 acres) was fenced in 2012 • historic structures including rock wall and cabin • contains portion of key access road to Lyon Creek drainage	• manage for wildlife and fisheries • access would be non-motorized only; walking/ bicycling trail, except for administrative use • increase water efficiency and quality – put more water into Lyon Creek for fisheries/riparian vegetation, but maintain meadow • grazing from adjacent BLM would likely continue to occur (meadow has subsequently been fenced with conservation easement established) • historic structures features would be candidates for cultural interpretive sites in collaboration with Custer County, Boise State University, Idaho Department of Parks and Recreation, and others; • if BWR-1 not acquired in fee simple, would need public access easement for access road
BWR-2	B	110	• primarily irrigated (wheel line and pivot) agriculture • pole barn • contains portion of key access road from Lyon Creek Bridge or Poverty Flat Road	• continue agricultural use • remove pond to eliminate fish barrier • if BWR-2 not acquired in fee simple, would need public access easement
BWR-3	C	39	• main (Lyon Creek) residence • apple orchard, garden, other fruit trees • homestead cabin • contains portion of key access road to Lyon Creek drainage	• facility would serve as Field School for Boise State University and partners, or others for environmental programs and outreach • continue in irrigated (pivot) agriculture • if BWR-3 not acquired in fee

Subparcel ID	RAC Parcel ID(s)	(acres)	Current Land Use(s)	RAC Proposed Land Use
				simple, would need public access easement
BWR-4	D, E, F; portion G	143	• Maraffio homestead with historic structures • modern (dilapidated) Maraffio residence (trailer on east side of the Salmon River) • irrigated (wheel line) agriculture • small portions adjacent to Challis Wild Horse and Burro Management Area	• some preservation of structure(s) could be done • demolish and remove the modern Maraffio residence • would continue in irrigated (wheel line) agriculture (Parcels E, G) • north end and central portions are possible sites for the Idaho Department of Parks and Recreation or another agency to develop campground, interpretive site, or other recreational facility that generates revenue
BWR-5	I; portions of D, E, F, G	98	• bare ground except wheel line agriculture at southern end • small portions adjacent to Challis Wild Horse and Burro Management Area	• continued agricultural use
BWR-6	H; portion of G	209	• primarily irrigated (pivot) agriculture • Sink Creek residence • contains portion of key access road	• continued agricultural use • Sink Creek residence would serve as ranch manager housing; contains possible site (between pivots) for the Idaho Department of Parks and Recreation or another agency to develop campground, interpretive site, or other recreational facility that generates revenue • if BWR-6 not acquired in fee simple, would need public access easement
BWR-7	No RAC	54	• no uses except grazing • patchy flood irrigation	• would be rested from grazing and subjected to weed

Subparcel ID	RAC Parcel ID(s)	(acres)	Current Land Use(s)	RAC Proposed Land Use
	parcel		• contains portion of key access road	eradication • if BWR-7 not acquired in fee simple, would need public access easement

Alternative L2-B

In addition to the RAC-recommended management of the ranch (Alternative L2), a sub-alternative for ranch management has been developed (Alternative L2-B). The sub-alternative is evaluated in Chapter 4 under the headings for Alternative L2; in general the effects would be the same, so only the resources that would be affected differently from Alternative L2 are described.

Alternative L2-B would be the same management as under Alternative L2, except 1) there would be no grazing at the ranch (on the fenced fields), 2) the cultivated fields would be actively converted to native vegetation, and 3) motorized access would be allowed in the Lyon Creek drainage to near the western edge of BWR-1 (where there are existing areas to park and turn around longer vehicles). The irrigated portions of the ranch (~ 400 acres) would actively be converted to native vegetation, except for the Lyon Creek meadow. The conversion would require approximately 3 years, and would consist of having a full-time ranch manager plow and/or use herbicide to kill the vegetation in the cultivated fields and roads, seed the fields with a native seed mixture, operate the existing irrigation systems, and manage an aggressive invasive and non-native plant (weed) eradication program. After 3 years the manager would also remove all of the ranch equipment except the fences. There would be a high probability of successful conversion, i.e., self-sustaining native vegetation, no excessive soil erosion/loss, and no major weed infestations (Redick 2013).

Table 2.2-2. Broken Wing Ranch subparcels, selected resources.

Subparcel	Resource Values			
	Wetlands, Floodplains and Riparian Areas	**Vegetation, Forest Resources, and Non-native and Invasive Plants**	**Range Resources**	**Cultural and Paleontological Resources**
BWR-1	21.46 acres wetland 0 miles Salmon River riparian/floodplain	5.2 acres riparian vegetation 24 % agricultural pasture	5 AUMs/acre (meadow)	CH-1521 Graham Homestead (eligible)[2]
BWR-2	1.09 acres wetlands 1.0 miles Salmon River riparian/floodplain	5.0 acres riparian vegetation 68 % agricultural pasture	8 AUMs/acre	None
BWR-3	0.61 acre wetland 0 miles Salmon River riparian/floodplain	3.4 acres riparian vegetation 16 % agricultural pasture	8 AUMs/acre[1]	CH-1520 Gini Homestead (eligible)[2] 37-4918 bridge (unevaluated)[2]
BWR-4	10.65 acres wetlands 1.3 miles Salmon River riparian/floodplain	4.8 acres riparian vegetation 88 % agricultural pasture	5-8 AUMs/acre	CH-1519 Maraffio Homestead (eligible)[2]
BWR-5	0 acres wetlands 0 miles Salmon River riparian/floodplain	0 acres riparian vegetation 13 % agricultural pasture	5-8 AUMs/acre	10CR990 talus pits (unevaluated)[2] 10CR988 lithic scatter (eligible)[2]
BWR-6	1.26 acres wetlands 1.4 miles Salmon River riparian/floodplain	3.8 acres riparian vegetation 69 % agricultural pasture	8 AUMs/acre[1]	37-17040 Sink Creek cribbing (eligible)[2]
BWR-7	1.91 acres wetlands 0.6 miles Salmon River riparian/floodplain	3.3 acres riparian vegetation 32 % agricultural pasture	7 AUMs/acre	None

[1] typical amount when irrigated (but not currently irrigated)
[2] NRHP status

2.2.2.3. Offered Lands – Garden Creek Property

The Garden Creek property consists of 82 acres of undeveloped, forested land southeast of Pocatello in Bannock County (Figure 2.2-2., Photo 2.2-12., Photo 2.2-13). Under Alternative L2 the Garden Creek property would be managed under the BLM Pocatello RMP with no site-specific management provisions for the property.



Photo 2.2-12. Garden Creek property, view to northeast.



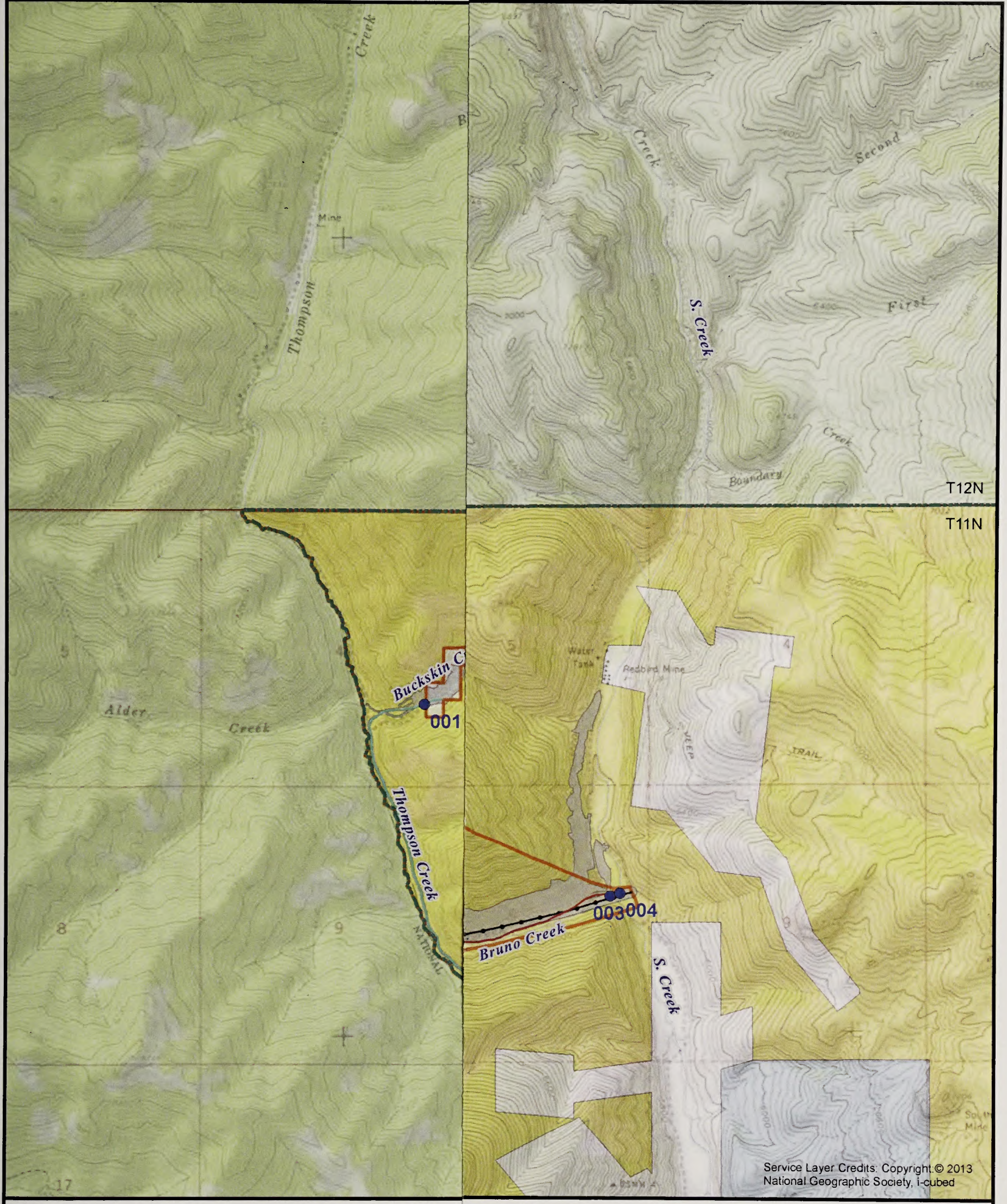
Photo 2.2-13. Garden Creek property, view to southeast.

2.2.3. Alternative L3 – Land Sale

The BLM would amend the Challis RMP to identify the selected land as suitable for disposal by sale under Section 203 of the FLPMA. The US would not obtain any of the offered lands. The selected land would be sold by a direct (non-competitive) sale to TCMC, a modified competitive sale (TCMC would be identified as the bidder authorized to meet the high bid), or a competitive sale (the highest bidder would receive title to the property). In the first case the sale would be at the appraised fair market value pursuant to Section 203 of the FLPMA and all other applicable laws, regulations (e.g. 43 CFR 2710).

2.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The BLM would amend the Challis RMP to identify approximately 3,600 acres of the selected land (rather than ~ 5,100 acres) as suitable for disposal, and the BLM would approve a land exchange in which TCMC would acquire approximately 3,600 acres of the selected land (Figure 2.2-4). The US would correspondingly acquire an equivalent fair market value (~ 30 % less by area) of the offered lands. To balance the reduced value of the selected land, the US would not acquire the Garden Creek property and/or lower priority portions of the Broken Wing Ranch.



by Ken Gardner.
aphic Sciences.

Legend

- Alternative L4 selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pynte pipeline
- Tailings pipeline
- Water pipeline

Land

Figure 2.2-4
Land Disposal Alternative L4 - Reduced area land exchange
Thompson Creek Mine EIS



Photo 2.2-13. Garden Creek property, view to southeast.

2.2.3. Alternative L3 – Land Sale

The BLM would amend the Challis RMP to identify the selected land as suitable for disposal by sale under Section 203 of the FLPMA. The US would not obtain any of the offered lands. The selected land would be sold by a direct (non-competitive) sale to TCMC, a modified competitive sale (TCMC would be identified as the bidder authorized to meet the high bid), or a competitive sale (the highest bidder would receive title to the property). In the first case the sale would be at the appraised fair market value pursuant to Section 203 of the FLPMA and all other applicable laws, regulations (e.g. 43 CFR 2710).

2.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The BLM would amend the Challis RMP to identify approximately 3,600 acres of the selected land (rather than ~ 5,100 acres) as suitable for disposal, and the BLM would approve a land exchange in which TCMC would acquire approximately 3,600 acres of the selected land (Figure 2.2-4). The US would correspondingly acquire an equivalent fair market value (~ 30 % less by area) of the offered lands. To balance the reduced value of the selected land, the US would not acquire the Garden Creek property and/or lower priority portions of the Broken Wing Ranch.

R16E R17E

T12N

T11N

Buckskin Waste Rock Storage Facility

Tailings Storage Facility

Open Pit

Shops/ Crusher/ Office

SRD

PWTP

Mill

Pat Hughes Waste Rock Storage Facility

Cherry Creek Pump Station

001

002

003

004

005 (Downstream to Thompson Creek and Salmon River Confluence)

Bruno Creek

Buckskin Creek

Thompson Creek

Mill Creek

Redbird Creek

Pat Hughes Creek

Cherry Creek

No Name Creek

S. Creek

Alder Creek

Redbird Mine

Twin Ace Mine

Water Tank

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Legend

- Alternative L4 selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

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0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.2-4
Land Disposal Alternative L4 - Reduced area land exchange
Thompson Creek Mine EIS

To give the decision maker reasonable flexibility in choosing the portions of the offered lands that would best serve the public interest, while maintaining similar fair market values of the selected land and offered lands, for purposes of this EIS the ranch was subdivided into subparcels (Figure 2.2-3., Table 2.2-2). The offered lands that the US would acquire would be administered by the BLM as described under Alternative L2 or Alternative L2-B (Section 2.2.2).

2.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The BLM would amend the Challis RMP to identify all of the selected land (~ 5,100 acres) as suitable for disposal under the FLPMA. The BLM would approve the land exchange proposal, but with approximately 1,500 acres of the selected land protected by a conservation easement held by the BLM (Figure 2.2-5). This alternative, a variation of Alternative L4, would result in a more compact land jurisdiction pattern in the vicinity of the mine, and would protect a block of the selected land on which mining activities are not foreseen and would not occur under the MMPO alternatives.

TCMC would therefore acquire the selected land, and the US would acquire most of the offered lands. However, unlike Alternative L2, approximately 1,500 acres of the selected land would be protected by a conservation easement requiring the land to remain essentially in its current condition, e.g., no residential development or mining. The lesser fair market value of the offered lands due to the easement would require eliminating either the Garden Creek parcel and/or certain subparcels of the Broken Wing Ranch from the land exchange, but to a lesser extent than under Alternative L4. That is, compared to Alternative L2, the US would acquire approximately 30 percent less (by fair market value) of the offered lands under Alternative L4 and approximately 10 percent less under Alternative L5. The offered lands that the US would acquire would be administered by the BLM as described in Alternative L2 or Alternative L2-B (Section 2.2.2).

2.2.6. Features Common to All Land Disposal Alternatives

Under all the land disposal alternatives the selected land would be utilized for mining as described for whichever MMPO alternative would be selected by the agencies.

2.2.7. Land Disposal Action Alternative Provisions

The seven following provisions would occur at or before title transfer under all of the land disposal action alternatives, unless under Alternative L3 the selected land was sold to a party other than TCMC. In such case, only the seventh provision would occur. The land disposal provisions were developed as part of the scoping process with input from TCMC prior to effects analysis, and are evaluated in the subsequent effects analysis as part of the action alternatives (as opposed to "mitigation" measures applied to an identified effect with subsequent re-analysis). The provisions would be donations from TCMC and would not affect the fair market value of the selected and offered lands.

1. *South Butte Road Access*
   TCMC would grant public access along two sections of the South Butte Road, which passes through private property owned by TCMC (Figure 2.2-6). This grant would formalize the public access that TCMC has allowed on the road since 1981. Such a grant would ensure future public access to approximately 7,000 acres of Federal and State lands that are now essentially inaccessible to the public, apart from the South Butte Road, due to rugged topography and the lack of public access via other roads.

2. *Twin Apex Property Access*
   The BLM would grant the owners of the Twin Apex property access to their property via the Bruno Creek Road, and TCMC would modify its exclusive right-of-way (granted by the BLM) for Bruno Creek Road to allow such access (Figure 2.2-6).

3. *Thompson Creek Road Access*
   The existing public access along the upper Thompson Creek Road would be retained by the US (Figure 2.2-7).

4. *Management for Big Game Including Provisions for Public Access*
   TCMC would pursue a donated Access Yes agreement through the IDFG Access Yes Program to allow non-motorized access for private or commercial hunters and anglers, as well as general recreationalists to the selected land with the exception of the land that drains into Bruno Creek, Buckskin Creek, Pat Hughes Creek and Cherry Creek (Figure 2.2-8). The restricted areas are for the safety of both the public and TCMC employees. The restricted areas would be posted at appropriate access points with maps explaining and delineating the restricted areas.

5. *S. Creek Grazing Allotment, Saturday Mountain Pasture*
   TCMC would grant administrative access to the BLM and its permittees to use roads on property owned by TCMC to reach the Saturday Mountain Pasture (Figure 2.2-6). The grant would guarantee continued access by these parties to approximately 2,500 acres of Federal and State lands (excluding the selected land) that are now essentially inaccessible to these parties without the case-by-case permission of TCMC, due to rugged topography, and the lack of legal access on existing roads. No new livestock grazing would result from such access because the Saturday Mountain Pasture is currently grazed.

6. *Challis East Subdivision Trail Access*
   TCMC would grant public access (motorized or non-motorized) via a trail within a 20 foot wide easement along one side of the perimeter of property owned by TCMC in the Challis East Subdivision provided that trail access is also acceptable to the subdivision property owners and/or the local government. The trail would provide a connection to the Lombard Trail around Blue Mountain, and could ultimately be part of a new trail system envisioned to the Salmon River (Figure 2.2-9).

T12N

T11N

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Legend

- Alternative L5 - selected land
- Modified east boundary
- Reduced area easement
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Figure 2.2-5
Land Disposal Alternative L5 - Reduced area land exchange with easement
Thompson Creek Mine EIS

1. *South Butte Road Access*
   TCMC would grant public access along two sections of the South Butte Road, which passes through private property owned by TCMC (Figure 2.2-6). This grant would formalize the public access that TCMC has allowed on the road since 1981. Such a grant would ensure future public access to approximately 7,000 acres of Federal and State lands that are now essentially inaccessible to the public, apart from the South Butte Road, due to rugged topography and the lack of public access via other roads.

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   The BLM would grant the owners of the Twin Apex property access to their property via the Bruno Creek Road, and TCMC would modify its exclusive right-of-way (granted by the BLM) for Bruno Creek Road to allow such access (Figure 2.2-6).

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R16E R17E

T12N

T11N

Buckskin Waste Rock Storage Facility

Open Pit

Tailings Storage Facility

SRD

Shops/ Crusher/ Office

PWTP

Mill

Pat Hughes Waste Rock Storage Facility

Cherry Creek Pump Station

001

002

003004

005 (Downstream to Thompson Creek and Salmon River Confluence)

Bruno Creek

Redbird Creek

Mill Creek

Buckskin Creek

Thompson Creek

No Name Creek

Pat Hughes Creek

Cherry Creek

S. Creek

Alder Creek

Redbird Mine

Twin Adit Mine

Service Layer Credits Copyright © 2013 National Geographic Society, i-cubed

Legend

- Alternative L5 - selected land
- Modified east boundary
- Reduced area easement
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

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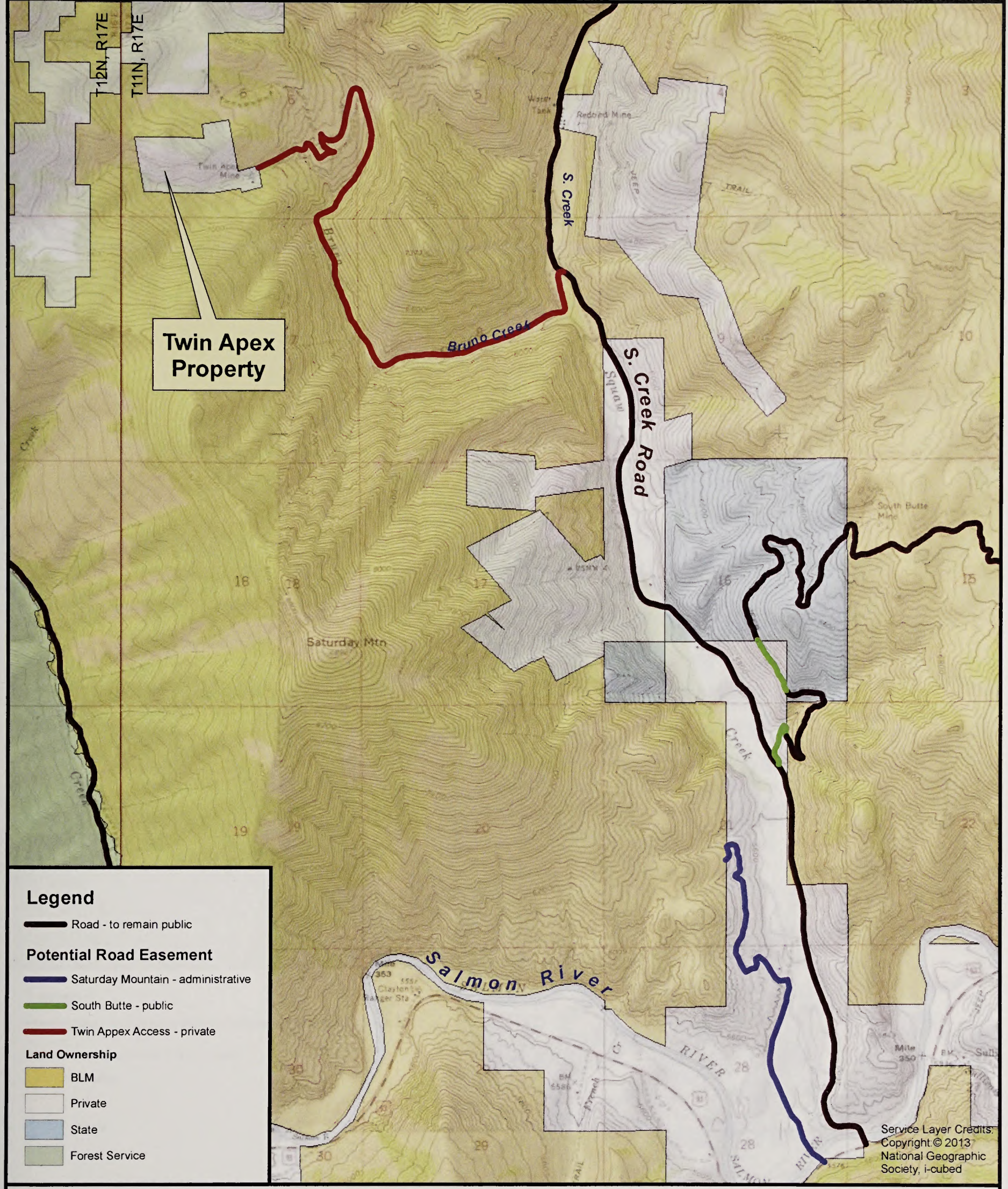
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Figure 2.2-5
Land Disposal Alternative L5 - Reduced area land exchange with easement
Thompson Creek Mine EIS



Potential Road Easement data developed by Ken Gardner, BLM.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

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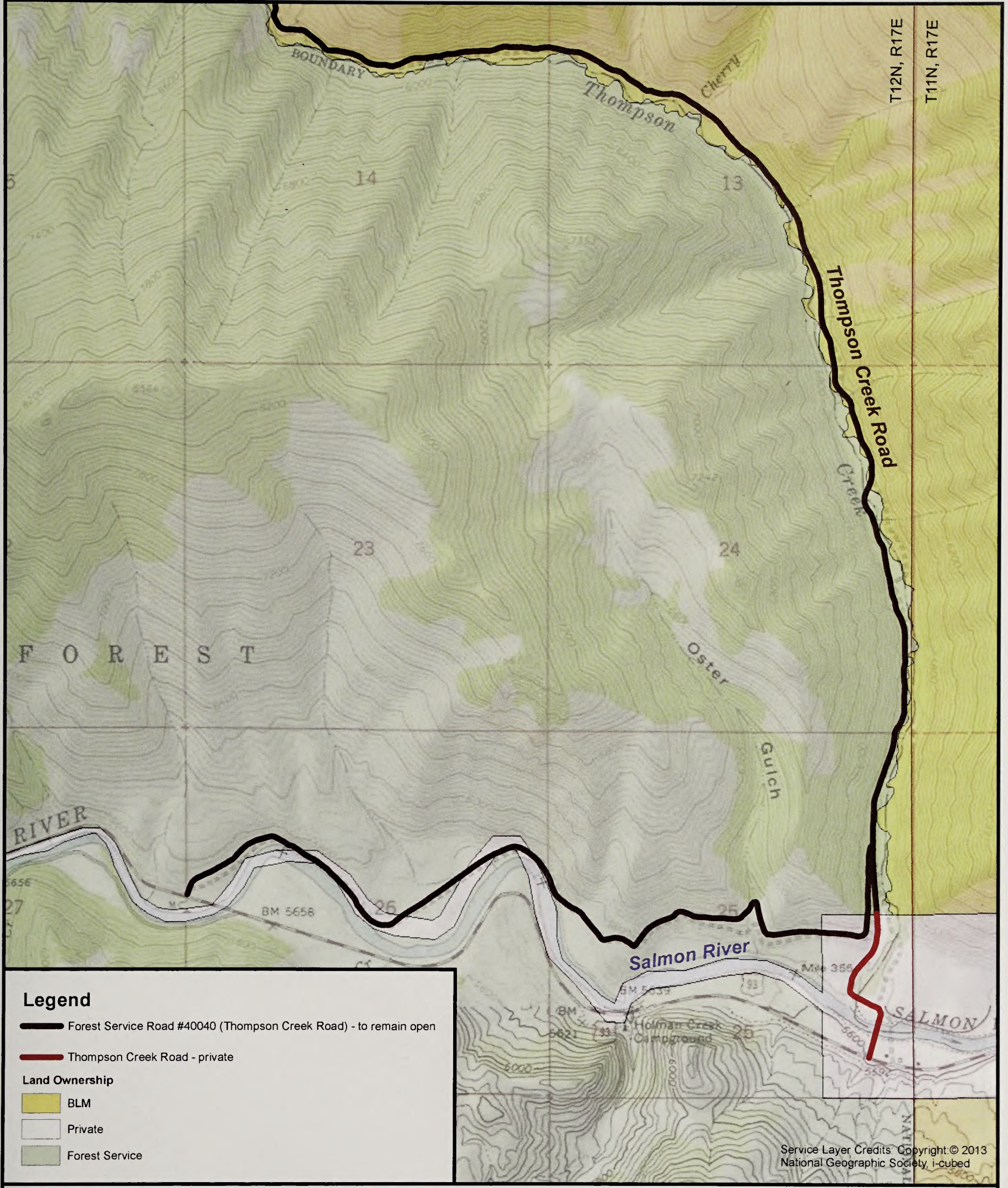
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Figure 2.2-6
Land disposal alternatives - potential easement on existing roads
Thompson Creek Mine EIS



Potential Road Easement data developed by Ken Gardner, BLM.
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Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

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Figure 2.2-7
Land disposal alternatives - Thompson Creek road access
Thompson Creek Mine EIS

T12N

T11N

Buckskin C

001

003004

Bruno Creek

S. Creek

Thompson Creek

Alder Creek

Redbird Mine

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Legend

- Selected lands
- Public access to selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Figure 2.2-8
Land disposal alternative - public access to selected land
Thompson Creek Mine EIS

R16E R17E

T12N

T11N

Buckskin Waste Rock Storage Facility

Tailings Storage Facility

Open Pit

SRD

Shops/ Crusher/ Office

PWTP

Mill

Pat Hughes Waste Rock Storage Facility

001

002

003

004

005 (Downstream to Thompson Creek and Salmon River Confluence)

Cherry Creek Pump Station

Bruno Creek

Redbird Creek

Mill Creek

Buckskin Creek

Thompson Creek

No Name Creek

Pat Hughes Creek

Cherry Creek

S. Creek

Bruno Creek

Redbird Mine

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Legend

- Selected lands
- Public access to selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- NPDES outfall
- Existing power line
- Pyrite pipeline
- Tailings pipeline
- Water pipeline

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

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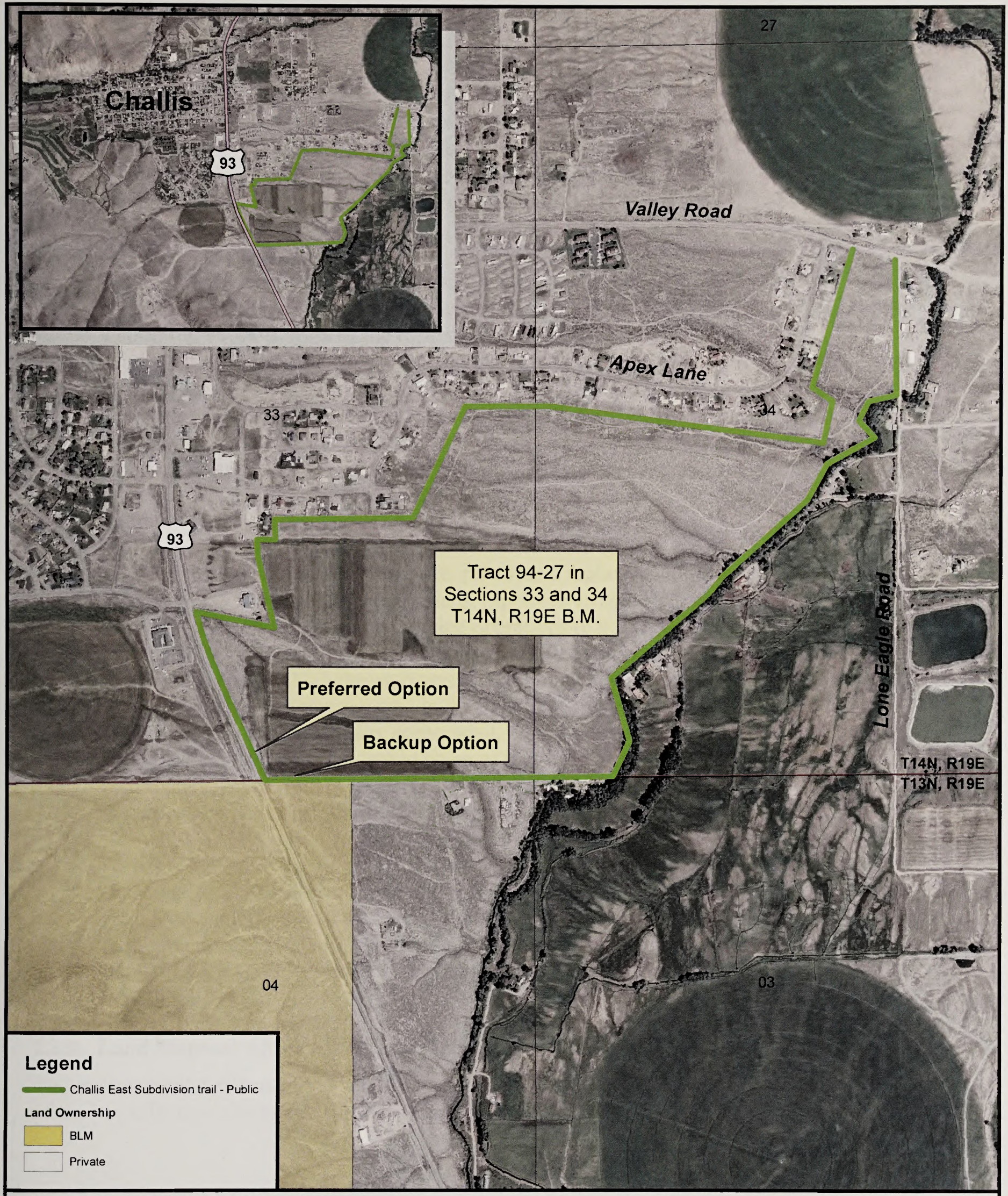
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No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.2-8
Land disposal alternative - public access to selected land
Thompson Creek Mine EIS



Potential Road Easement data developed by Ken Gardner, BLM.
Ownership data is at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Aerial image NAIP 2009
Coordinate system UTM Zone 11 NAD 83

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Feet

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Meters

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 2.2-9
Land disposal alternatives - trail easement, Challis East Subdivision
Thompson Creek Mine EIS

7. *Thompson Creek and S. Creek Conservation Easement*
TCMC[13] would grant the BLM a conservation easement for the following areas: 1) the area of the selected land within ⅛ mile of the centerline of Thompson Creek (~ 4 miles of stream length, ~ 280 acres), and 2) the area of the selected land within ⅛ mile of the centerline of the portions of S. Creek within the selected land (~ ½ mile of stream length, ~ 70 acres) (Figure 2.2-1).

In the S. Creek portion of the easement area, the easement would prohibit subdivision/residential development and protect the Bruno Creek fossil locality. In the Thompson Creek portion of the easement area, the easement would prohibit subdivision/residential development as well as all other activities contrary to the purpose of the easement: to preserve, protect, enhance, and restore the conservation values of Thompson Creek in perpetuity including the open-space, scenic and relatively natural features and values of the property, as well as the ESA-designated critical habitat for Chinook salmon, bull trout, and steelhead. In particular, the easement would conserve the diversity of ESA-listed resident and anadromous fish species native to the Upper Salmon watershed.

The easement would allow for the use, repair, and replacement of the existing infrastructure such as roads, power lines, pipelines, irrigation ditches, etc. within the easement area, and for unforeseen mine operations (e.g., extensions of power lines or pipelines for long-term water management) which would not materially degrade the riparian values for which the easement would be intended to protect. The easement area would exclude a non-riparian area in the lower Pat Hughes Creek drainage (~ 5 acres) which contains the Pat Hughes access road, pipeline, topsoil storage stockpile, etc. and in which new mine operations would occur as part of Phase 8. Any projects with new disturbance would need to be accepted by the BLM prior to implementation to ensure the disturbance would conform to the easement.

As livestock grazing is not currently permitted along Thompson Creek on BLM land, the easement would prohibit grazing within the Thompson Creek portion of the easement area. Any grazing within the easement area along S. Creek would conform to the grazing requirements of the Challis RMP which has been determined to be in conformance with the INFISH/PACFISH standards and guidelines for riparian areas (INFISH 1995, PACFISH 1995).

2.2.8. Land Disposal Alternatives Comparison

The environmental effects of the land disposal alternatives are described in Chapter 4, and some of the key effects are summarized below (Table 2.2-3).

[13] or another owner if the selected land was sold to a party other than TCMC under Alternative L3; the easement could also be a reservation attached to the selected land by the BLM prior to title transfer

Table 2.2-3. Effects comparison, land disposal alternatives.

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
GEOLOGIC RESOURCES AND GEOTECHNICAL ISSUES					
Saleable, locatable or leasable mineral availability	No change to existing conditions	Negligible effect to mineral availability	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2
SOIL RESOURCES					
Acres or % of area of soil compaction, change to productivity, erosion potential	No change to existing conditions	No effects to the selected land. Small areas of soil at ranch could become compacted from parking areas, campgrounds. Under L2-B ~ 52 % of the soil at the ranch would be altered by the conversion to native vegetation.	No effects to the selected or offered lands	No effects to the selected land. Effects to the offered lands would be the same as Alternative L2, except land removed from the transaction would not be subject to potential limited soil compaction from development.	No effects to the selected land. Effects to the offered lands would be the same as Alternative L4.
VEGETATION, FOREST RESOURCES, AND INVASIVE AND NON-NATIVE PLANTS					
Area of special status plant habitat	No change to existing conditions	365 acres of occupied or potentially occupied special status plant habitat on ranch would come under BLM administration	No change to existing conditions	Same as Alternative L2, except the area would change to achieve equal value	Same as Alternative L2, except the area would change to achieve equal value

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
RANGE RESOURCES					
Area of suitable grazing lands	No change to existing conditions	Decrease of 80 % of suitable grazing lands (major, long term) on selected land	Same as Alternative L2	Decrease of 71 % of suitable grazing lands (major, long term) on selected land	Same as Alternative L2
Change in AUMs	No change to existing conditions	Decrease of 80 % of AUMs (major, long term) on selected land	Same as Alternative L2	Decrease of 69 % of AUMs (major, long term) on selected land	Same as Alternative L2
WATER RESOURCES					
Water quality (no indicators)	No change to existing conditions	No effect to selected land or Garden Creek property Negligible effect to Salmon River due to sediment delivery from BLM-recommended management such as campground or boat launch; riparian improvements would cause negligible reduction in sediment delivery to Salmon River Restoration of Lyon Creek would restore a more normal flow with less erosion and sediment input into the lower 1,850 ft. of Lyon Creek (long-term, moderate effect).	No change to existing conditions	Effects would be the same as Alternative L2, except the effects related to subparcels (~ 30 % less by fair market value compared to Alternative L2) that would not be acquired by the US would not occur	Effects would be the same as Alternative L2, except the effects related to subparcels (~ 10 % less by fair market value compared to Alternative L2) that would not be acquired by the US would not occur

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
Water quantity (change in flow)	No change to existing conditions	No effect to selected land or Garden Creek property No change to flow or volume associated with water rights on Broken Wing Ranch	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
WILDLIFE RESOURCES					
Area of special status wildlife habitat	No change to existing conditions	No change to existing conditions	No change to existing conditions	No change to existing conditions	No change to existing conditions
Hunting pressure	No change to existing conditions	Increased hunting pressure (long-term, minor effect)	No change to existing conditions	Increased hunting pressure (long-term, minor effect)	Increased hunting pressure (long-term, minor effect)
FISH AND AQUATIC RESOURCES					
Amount of suitable habitat	No change to existing conditions	No effect to Garden Creek property; net increase in both suitable habitat and designated critical habitat under BLM jurisdiction Restoration of Lyon Creek would decrease water temperatures and improve fish habitat and thermal refugia.	Decrease of 5.3 miles of occupied designated critical habitat under BLM jurisdiction; however, no new disturbance would occur adjacent to streams	Same as Alternative L2	Same as Alternative L2

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
Habitat quality	No change to existing conditions	No effect to selected land or Garden Creek property; long-term, moderate beneficial effect to aquatic habitat in Lyon Creek and Salmon River	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
WETLANDS, FLOODPLAINS, AND RIPARIAN AREAS					
Area of wetlands	No change to existing conditions	49.69 acres of wetlands would leave Federal jurisdiction; 37.68 acres of wetlands would enter Federal jurisdiction; improvements to riparian areas along Salmon River on the ranch	49.69 acres of wetlands would leave Federal jurisdiction	21.72 acres would leave Federal jurisdiction; unknown area would enter Federal jurisdiction, but would probably be less than 37.68 acres	Same as Alternative L4, except slightly more wetlands would probably enter Federal jurisdiction
AIR QUALITY, NOISE, AND CLIMATE CHANGE					
Change in noise at ranch and in Lyon Creek	No change to existing conditions	Minor increase in noise due to agricultural activities	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
VISUAL (AESTHETIC) RESOURCES					
Changes in scenery	No change to existing conditions	Subtle visual changes to ranch due to BLM administration	No change to existing conditions	Same as Alternative L2	Same as Alternative L2

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
LAND USE AND RECREATION					
Area of Federal land	No change to existing conditions	Net decrease of 4,300 acres of Federal land in the BLM Challis Field Office area (negligible effect); net increase of 82 acres in the BLM Pocatello Field Office area (negligible effect)	Net decrease of 5,100 acres of Federal land in the BLM Challis Field Office area (negligible effect)	Decrease of 3,600 acres of Federal land in the BLM Challis Field Office area (selected land); increase of 895 acres less ~ 30 % by fair market value in The BLM Challis and Pocatello Field Office areas	Decrease of 5,100 acres of Federal land in the BLM Challis Field Office area (selected land); increase of 895 acres less ~ 10 % by fair market value in the BLM Challis and Pocatello Field Office areas
Recreational use	No change to existing conditions	Negligible effects due to reduced access to some portions of selected land; public recreation opportunities increased on ranch and Garden Creek property	Same as Alternative L2	Negligible effects due to reduced access to some portions of selected land; public recreation opportunities increased on ranch but less than Alternative L2	Negligible effects due to reduced access to some portions of selected land; public recreation opportunities increased on ranch, less than Alternative L2 but more than Alternative L4
SOCIOECONOMIC FACTORS					
Tax revenue	No change to existing conditions	Negligible effects to tax revenue	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2
BLM revenue	No change to existing conditions	Negligible effects to BLM revenue	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2
TRIBAL TREATY RIGHTS AND INTERESTS					
Area of unoccupied Federal land	No change to existing conditions	< 1 % decrease in unoccupied Federal land (minor, permanent, adverse)	Same as Alternative L2	Same as Alternative L2	Same as Alternative L2

Indicator	Alternative L1	Alternative L2	Alternative L3	Alternative L4	Alternative L5
CULTURAL RESOURCES					
Cultural resource sites	No change to existing conditions	5 NRHP-eligible and 2 potentially eligible sites would come under BLM management (on ranch)	No change to existing conditions	The effect to cultural resource sites would be similar to Alternative L2, but the number of sites would depend on which subparcels were acquired by the US	The effect to cultural resource sites would be similar, but the number of sites would depend on which subparcels were acquired by the US
TRANSPORTATION, ACCESS, AND PUBLIC SAFETY					
Access to grazing allotments	No effect on existing conditions	Access to grazing would increase	No change to existing conditions	Same as Alternative L2	Same as Alternative L2
HAZARDOUS MATERIALS AND HAZARDOUS AND SOLID WASTE					
Chance for releases or dumping on ranch	No effect on existing conditions	Minor increase in potential for dumping (because public land)	No change to existing conditions	Same as Alternative L2	Same as Alternative L2

2.2.9. Monitoring and Mitigation

The BLM would document the baseline condition of the lands subject to conservation easements administered by the BLM. The BLM would monitor these lands (e.g., annual field inspections) to ensure the lands remain in compliance with the easements. In the case of the land disposal action alternatives, the mine would continue to be inspected by a variety of Federal and State agencies, less the BLM[14] (Section 2.1.1.7).

2.2.10. Financial Guarantee

Under the land disposal action alternatives the mine might no longer be subject to the BLM surface management regulations for mining – some facilities such as the Cherry Creek pump station are not on the selected land and would remain on BLM land, but such facilities might be authorized under the FLPMA instead of Federal mining laws and the BLM surface management regulations. In such case, the financial guarantee(s) held by the BLM would be replaced with an equivalent financial guarantee(s) held by the IDL. However, the IDL may not have the authority to hold a financial guarantee for long-term water quality or other long-term, post-mining maintenance. Consequently, any ROD approving the land exchange would be conditional on TCMC establishing an irrevocable trust fund or other funding mechanism with the IDL for such long-term water treatment or other long-term requirements. The trust fund or funding mechanism would be identical or similar to that required by 43 CFR 3809.552(c) (Section 1.9.21., Section 4.13.4).

2.2.11. Land Disposal Alternatives Considered but Eliminated from Further Analysis

Additional Alternatives for Offered Lands

The BLM considered reducing the area of the selected land to only that land on which surface disturbance would occur under the MMPO alternatives. However, such would produce a spider-web of intertwined BLM and private lands that could not reasonably be managed, e.g., "islands" and long, narrow, irregular strips of land. Alternative L4 is the most reasonable "minimal area" alternative.

The BLM could develop additional land disposal alternatives involving private lands other than those offered by TCMC. Such alternatives would provide other options for the BLM to obtain private lands which possess resource qualities considered to be of substantial value to the public, e.g., wetlands in the Chilly Slough locality or other private land containing perennial streams. However, the BLM cannot require a proponent to offer a particular property, and will not evaluate a land exchange for which the proponent does not reasonably control offered lands with a fair market value similar to that of the selected lands. For these reasons, it is outside the scope of the project to evaluate a land disposal alternative with private lands other than those offered by TCMC.

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[14] Mine inspections and enforcement actions are administrative matters and not NEPA issues. Consequently, the MMPO and land exchange proposed by TCMC must be evaluated in the NEPA process as described by the proponent. For example, the analysis may not speculate "What if the proponent does not abide by the terms and conditions of an approved plan of operations?"

Return Broken Wing Ranch Passively to Native Vegetation

Under this component of all of the land disposal action alternatives, the Broken Wing Ranch would be returned to native vegetation with no irrigated agriculture and all existing roads would be reclaimed. The irrigation equipment would be removed and the ranch would be ploughed and/or treated with herbicide and seeded with native vegetation. However, 100 years of agriculture has fundamentally altered the chemistry of soil at the ranch, and experience in Custer County has shown that such attempted conversions lead to substantial noxious weed infestations and increased soil erosion within a few years unless major replanting and weed eradication efforts are made each year for decades. An active conversion to native vegetation is analyzed in this FEIS as Alternative L2-B (sub-alternative to Alternative L2) (Section 2.2.2).

Move Selected Land Boundary 500 yards East and North of Thompson Creek

This alternative, obtained from public scoping, was proposed to allow cattle grazing of the riparian habitat along Thompson Creek to continue to be permitted by the BLM. Under this alternative the boundary of the selected land would be moved 500 yards east and north of the centerline of Thompson Creek, leaving a 500 yard wide strip of BLM land between private land and the Forest Service boundary along the centerline of Thompson Creek. Creating such a long and narrow strip of BLM land would distinctly conflict with the fundamental land management objective of obtaining/maintaining block ownership for efficient and practicable land management (Section 2.2). Similarly, but with a goal to protect the Thompson Creek riparian area, the agencies considered if a strip of land (⅛ mile wide) could be incorporated into the adjacent SCNF (i.e., the land would continue to be part of a relatively large block of Federal land, but administered by the Forest Service under Forest Service laws and regulations). However, this alternative would require an act of Congress to modify the boundary of the SCNF. The agencies also considered that the strip of land (⅛ mile wide) could remain Federal land under BLM laws, regulations, the Challis RMP, etc., but the Forest Service would administer the strip of land on behalf of the BLM. This variation of the alternative would be administratively cumbersome to the point where the alternative would not be feasible (e.g., perpetual interagency agreements; Forest Service personnel would need to learn BLM laws, regulations, applicable guidance, etc).

Reduced Area Land Exchange, Conservation Easement Strategy

Under this alternative the selected land would be reduced from approximately 5,100 acres to 3,600 acres as under Alternative L4. However, instead of correspondingly reducing the fair market value of the offered lands by reducing their area, their fair market value would be correspondingly reduced via a conservation easement, e.g., substantial public access and land preservation conditions on large portions or all of the Broken Wing Ranch. The offered lands would thus comprise fee simple title to the Garden Creek property and a perpetual conservation easement running with the ranch (or portions of the ranch with fee simple title offered for the remaining area of the ranch depending on the necessary fair market value). That is, TCMC would own the ranch with greatly reduced fair market value, and the BLM would own a conservation easement with great public value. Upon completion of such land exchange, TCMC would probably sell its remaining ownership in the ranch to another private party, and the BLM would be responsible for administering the easement. However, the complexities of trying to establish the "arm's length" fair market value of such easement, the challenges in long-term

management of a conservation easement, and the probable elimination of the recreation site and Boise State University field station options make this alternative technically impractical and not desirable by the BLM.

CHAPTER 3

AFFECTED ENVIRONMENT

CHAPTER 3 – AFFECTED ENVIRONMENT

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3.0. AFFECTED ENVIRONMENT

3.1. Introduction

This chapter describes the affected environment for the MMPO and land disposal alternatives. The affected environment is the baseline (reference) condition against which the effects of the MMPO and land disposal alternatives are compared. The description of the affected environment is presented in 16[1] sections:

3.2. Geologic Resources and Geotechnical Issues
3.3. Soil Resources
3.4. Vegetation, Forest Resources, and Invasive and Non-native Plants
3.5. Range Resources
3.6. Water Resources
3.7. Wildlife Resources
3.8. Fish and Aquatic Resources
3.9. Wetlands, Floodplains, and Riparian Areas
3.10. Air Quality, Noise, and Climate Change
3.11. Visual (Aesthetic) Resources
3.12. Land Use and Recreation
3.13. Socioeconomic Factors
3.14. Tribal Treaty Rights and Interests
3.15. Cultural Resources
3.16. Transportation, Access, and Public Safety
3.17. Hazardous Materials and Solid Waste

Given the size of the sections for most resources in this chapter and in Chapter 4, the reader may wish to read the sections for each resource by alternating chapters, e.g., Section 3.2., Section 4.2., Section 3.3., Section 4.3., etc. Unless otherwise noted, the *MMPO area* refers to the area of new surface disturbance proposed under each MMPO alternative. The geographic scope of the affected environment (and of the effects analysis in Chapter 4) is the *analysis area.* The analysis area is described for each resource in the introduction of each of the following sections. The information in these sections is summarized from the technical reports for each of the resources (JBR 2014a through JBR 2014p); the technical reports include extensive background information and references. Metric units in their standard abbreviations are used in a few cases in the FEIS, e.g., when the units are standard for a particular parameter such as µg/L for water quality (chemistry) measurements, or when the units are carried forward from original data to facilitate comparisons with the original data.

3.2. Geologic Resources and Geotechnical Issues

The analysis area for geologic resources and geotechnical issues for the MMPO alternatives is the locality of the mine (an area of ~ 14,000 acres between Thompson Creek to the west and

[1] *resource* refers to elements of the human environment including items not commonly viewed as "resources" such as invasive, non-native plants and hazardous materials.

S.[2] Creek to the east, Figure 1.2-1). The analysis area for the land disposal alternatives is the selected and offered lands.

The analysis area for paleontological resources for the MMPO alternatives is the MMPO area. The analysis area for paleontological resources for the land disposal alternatives is the selected and offered lands. Paleontological resources are any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth, except that the term does not include any materials associated with an archaeological resource or cultural item. Information concerning the nature and specific location of a paleontological resource may generally not be disclosed to the public (16 USC 470aaa8).

3.2.1. MMPO Area and Selected Land

3.2.1.1. Geology

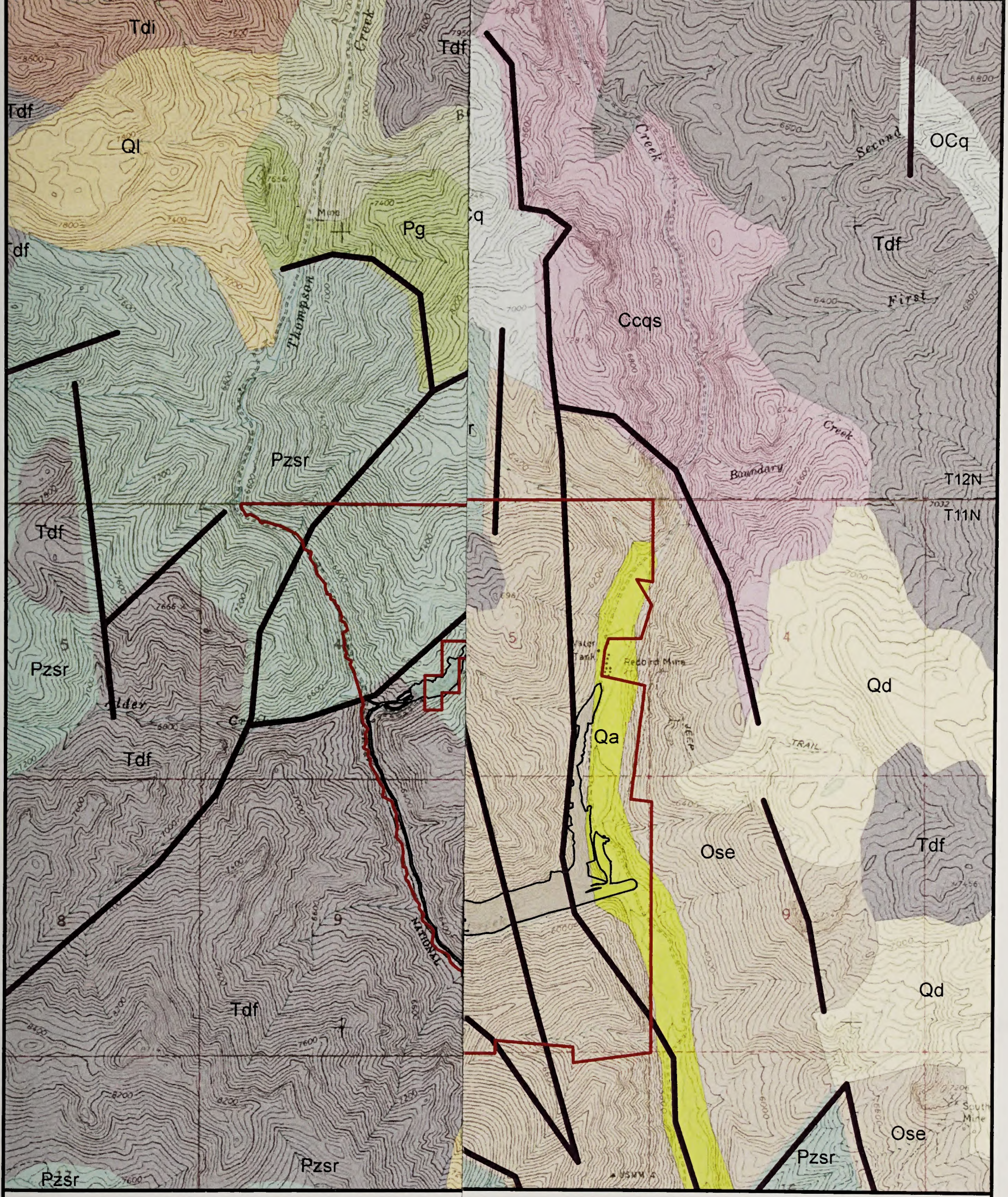
The surficial geology of the analysis area, mapped by Fisher et al. (1992) and Fisher and Johnson (1995), comprises a basement of Paleozoic sedimentary, metasedimentary, and metamorphic rocks (Figure 3.2-1). These rocks were intruded by the Cretaceous Idaho Batholith, and then during the Eocene both of these rock packages were intruded and unconformably overlain by the Challis Volcanic Group. Finally, these rocks were locally overlain by Tertiary and Quaternary deposits of colluvium (gravity deposited, e.g., talus) and alluvium (water deposited, e.g., stream gravel). The early to middle Cretaceous granitic rocks of the Idaho Batholith (Skipp 1987) and/or other Cretaceous granitic plutons (Kiilsgaard and Lewis 1985) cut through most of the thrust plates. These intrusions caused an uplift which resulted in further deformation (VTN 1980b) and were the source of the Thompson Creek molybdenite (MoS_2) deposit.

In general, the regional structure can be characterized by 1) a northeast-trending system of grabens and numerous sub-parallel, high-angle faults, fracture system, and dike swarms; 2) a system of high angle faults trending to the north and northwest; 3) caldera and collapse features associated with the Challis Volcanic Group; and 4) numerous thrust faults in the Paleozoic formations (Fisher 1985, Hobbs 1985, McIntyre et al. 1982).

The thickness of the basement rocks exceeds 37,000 feet in the region (Ekren 1985, Ruppel 1982, Tysdal 2002). The Lost River thrust plate is more than 16,000 feet thick (Skipp 1985). The Precambrian and Paleozoic basement surface is unconformably overlain by up to 5,000 feet of the Challis Volcanic Group, and has a relief of more than 2,000 feet due to weathering and structural deformation (Siems et al. 1978, Ekren 1985, Hobbs et al. 1991, Sanford 2005, Gardner 2008). The unconformity represents approximately 240 million years ago during which time the Thompson Creek intrusive complex became exposed as an erosional window (Hall et al. 1984).

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[2] *Squaw Creek* is an official place name in Custer County, and appears in numerous published documents including US Geological Survey (USGS) topographic maps. The name was established by the US Board of Geographic Names to maintain uniform geographic name usage throughout the Federal Government. However, the word *squaw* is offensive to some people including the Shoshone-Bannock Tribes. Therefore, *Squaw Creek* is hereafter referred to in the main text as *S. Creek*.



Gardner.

Figure 3.2-1
Surficial geology of the mine and selected land
Thompson Creek Mine EIS

S.[2] Creek to the east, Figure 1.2-1). The analysis area for the land disposal alternatives is the selected and offered lands.

The analysis area for paleontological resources for the MMPO alternatives is the MMPO area. The analysis area for paleontological resources for the land disposal alternatives is the selected and offered lands. Paleontological resources are any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth, except that the term does not include any materials associated with an archaeological resource or cultural item. Information concerning the nature and specific location of a paleontological resource may generally not be disclosed to the public (16 USC 470aaa8).

3.2.1. MMPO Area and Selected Land

3.2.1.1. Geology

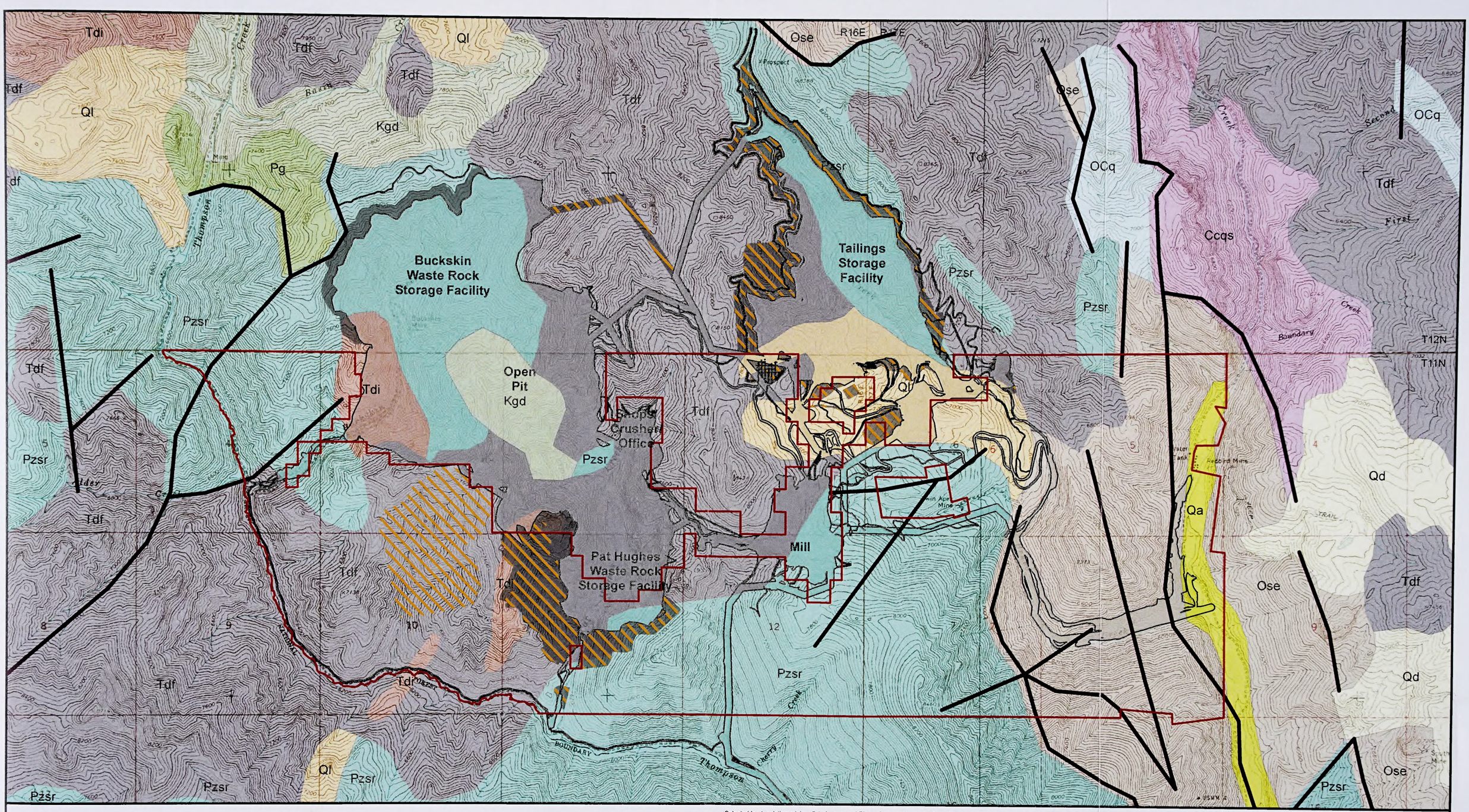
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Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

Geology

- Qa, Alluvium undivided
- Qd, Quaternary deposits undivided
- Ql, Landslide and related deposits
- Ccqs, Quartzite shale and carbonate rocks of the Squaw Creek area
- Kgd, Biotite granodiorite
- QCq, Quartzite
- Ose, Saturday Mountain Formation Kinnikinic Quartzite and Ella Dolomite undivided
- Pg, Grand Prize Formation
- Pzsr, Salmon River assemblage
- Tdf, Dacitic and rhyodacitic lava
- Tdi, Dikes and plugs of intermediate composition
- Fault

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Geologic data from digital geology from Fisher and Johnson supplied by Ken Gardner of BLM.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.2-1
Surficial geology of the mine and selected land
Thompson Creek Mine EIS

Ore deposits in the region developed during the Paleozoic, Cretaceous (Idaho batholith, Thompson Creek deposit), and Tertiary (Challis Volcanic Group). The Thompson Creek deposit is part of a magmatic intrusive emplaced during late Mesozoic-Tertiary time in western North American from California to Alaska, which hosts many substantial molybdenite stockwork deposits (Theodore and Menzie 1984).

The Thompson Creek stock is elongate from northwest to southeast and is at least 1.5 miles long and approximately 0.6 miles wide (Hall et al. 1984, Hall 1995). The ore body lies in both biotite granodiorite and quartz monzonite, and is approximately concordant with their contact. Molybdenite is strictly confined to a stockwork within the intrusive complex. The mineable ore body (> 0.02 % molybdenum) is 4,500 feet long, 1,900 feet wide, and 2,200 feet thick (Hall et al. 1984, Marek and Lechner 2011). The highest ore grades are at the crest of the quartz monzonite, and the ore grade decreases outward (Figure 3.2-2., Figure 3.2-3). The molybdenite generally occurs as stringers along the margins of narrow quartz veins and veinlets which cut the skarn (i.e., calc-silicate altered argillite) (Schmidt et al. 1991) ("metasediments" in Figure 3.2-2). Silicification and pyrite occur within both host rocks and the intrusive stock. Sulfide minerals other than molybdenite and pyrite are scarce.

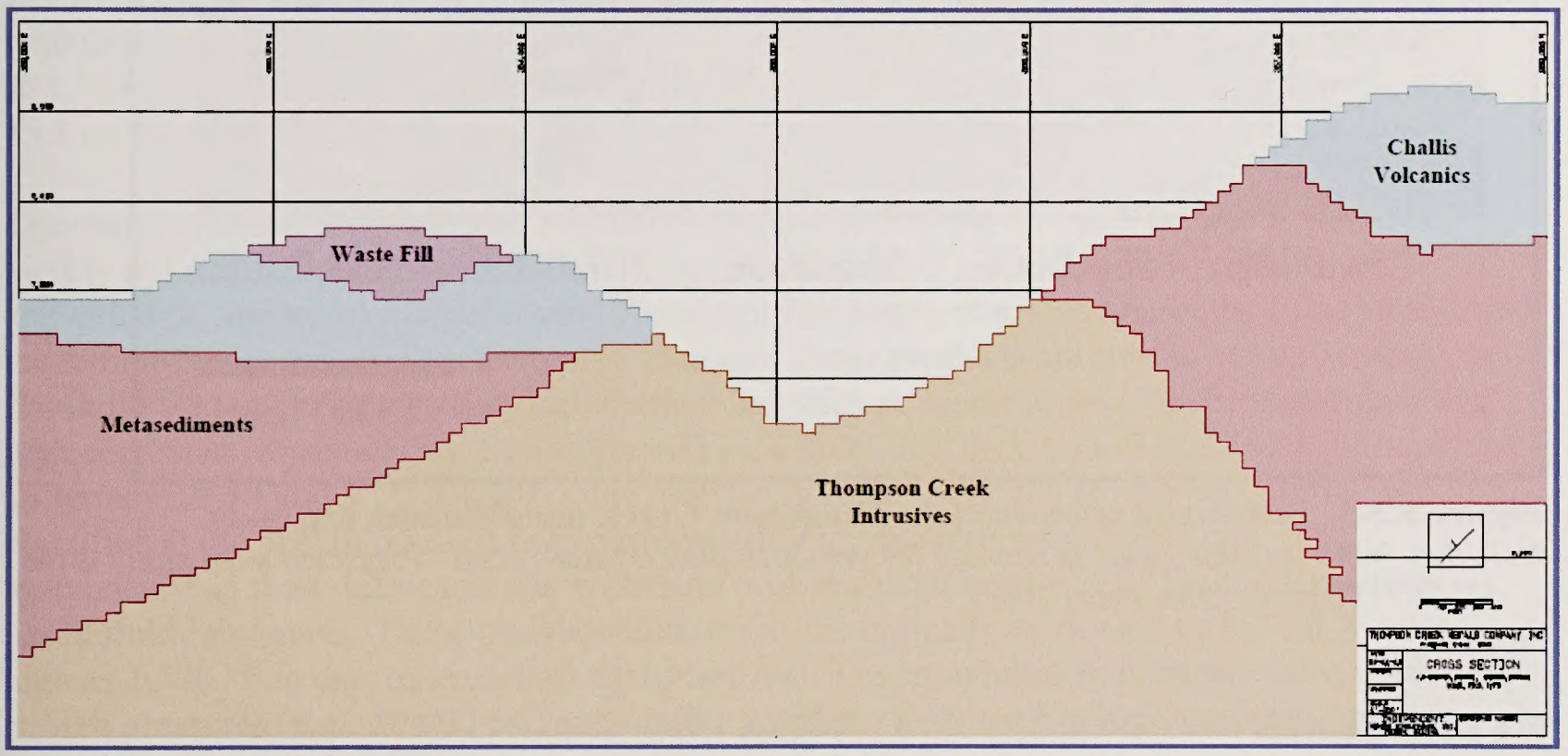


Figure 3.2-2. Cross-section through open pit, view to northwest.
grid spacing = 1,000 feet horizontal, 500 feet vertical (Marek and Lechner 2011)

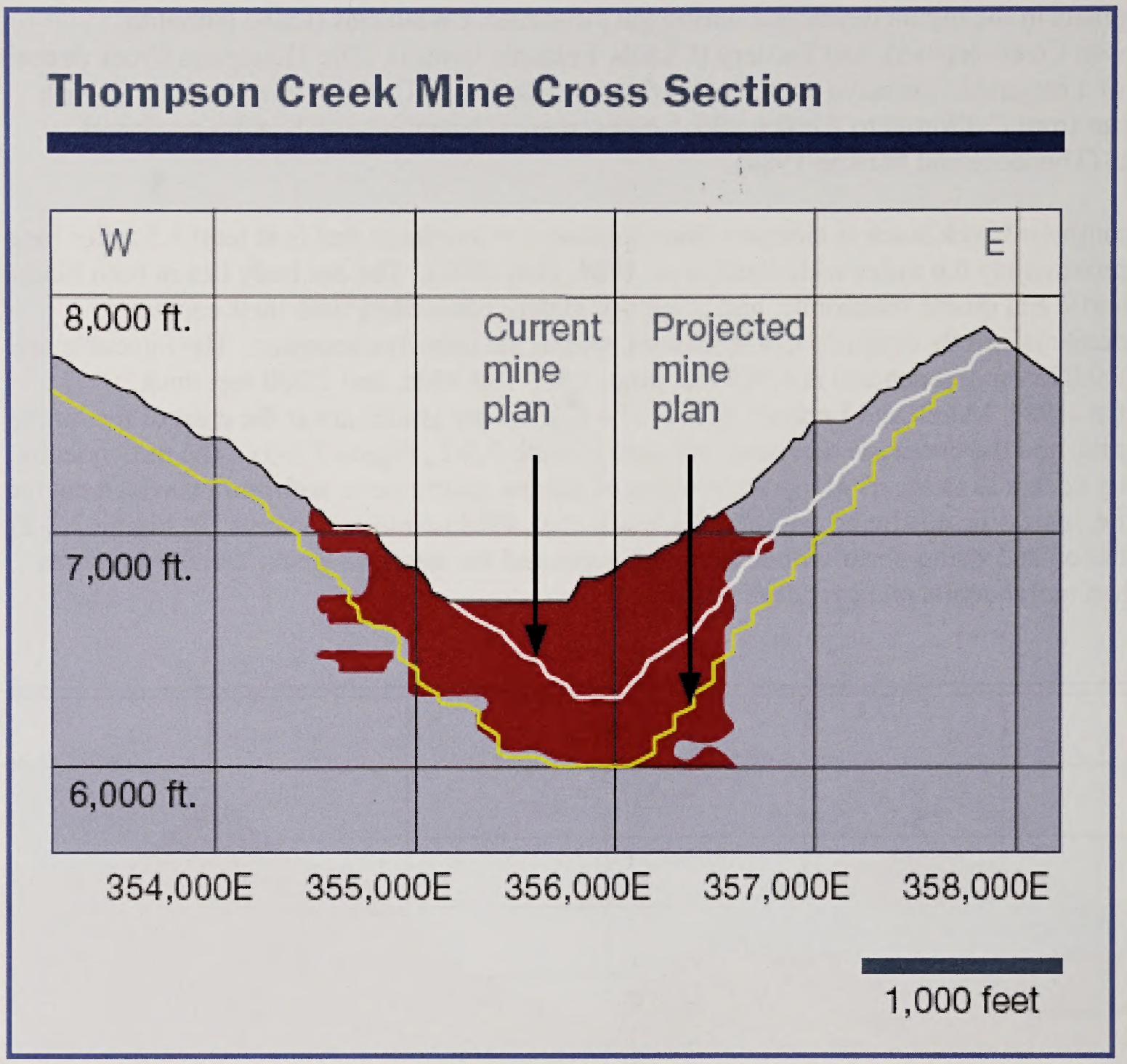


Figure 3.2-3. Schematic cross-section, Thompson Creek molybdenum ore body.
Note that "Current mine plan" is actually the pre-2010 plan (Phase 7) and "Projected mine plan" is the MMPO (Phase 8) (Blue Pearl 2006).

3.2.1.2. Minerals

The Federal Government classifies all minerals as either salable, leasable, or locatable. Salable minerals include common varieties of clay, sand, stone, gravel, cinders, pumice, pumicite, or cinders, i.e., minerals that are generally abundant with low unit value (e.g., $/ton) and ordinary uses. Leasable minerals include coal, phosphate, silicate, or nitrate minerals of potassium and sodium; sulfur in Louisiana and New Mexico; sulfate, carbonate, borate, chloride, oil, oil shale, native asphalt, solid and semi-solid bitumen, bituminous rock, gas, all minerals on the Outer Continental Shelf, and geothermal resources and associated by-products. Locatable minerals are those minerals that are not saleable or leasable, e.g., base and precious metals, gems and semi-precious stones, and certain industrial minerals. Molybdenum is a locatable mineral and is therefore mined on Federal land under Federal mining laws without purchase or lease from the Federal Government. Any portions of the selected land disposed of by the US would comprise

both the surface and mineral estate, i.e., the US would not reserve any mineral rights (and mining claims could no longer be located) on such selected land.

The ore deposit originally contained 193 million tons with an average grade of 0.112 percent molybdenum in 1980 (VTN 1980b), at a cutoff grade of 0.05 percent molybdenum (Schmidt 1991). The reserves in 2006 were 71.1 million tons with an average grade of 0.119 percent molybdenum. The measured and indicated resources were 196.7 million tons with an average grade of 0.094 percent molybdenum, and the inferred resources are 38.0 million tons with an average grade of 0.066 percent molybdenum (Blue Pearl 2006). Subsequent geologic and engineering work increased the proven and probable reserves in 2011 to 150.5 million tons with an average grade of 0.080 percent molybdenum at a cutoff grade of 0.030 percent molybdenum (Marek and Lechner 2011).

The mill can process as much as 31,000 tons per day of ore (Platts 2007) depending on the hardness of the ore, but was designed to process an average of 25,000 tons per day for an annual production of 15 to 20 million pounds of molybdenum in the form of a 90 percent molybdenite concentrate (Neumann and Gibson 1984, VTN 1980b). The mine began production in 1983, and continuously operated until 1992 when low molybdenum prices resulted in a shutdown during 1993. Operations resumed in March 1994 and production has continued uninterrupted since, but with slowdowns during some years due to low molybdenum prices.[3] The mine has produced 388.3 million pounds of molybdenum through 2012, with a record annual production of 25.3 million pounds of molybdenum in 2010.

The majority of the molybdenum concentrates produced by the mill are shipped to a roasting facility in Langeloth, Pennsylvania where approximately 75 percent of the molybdenite is converted to "technical molybdenum" powder or briquettes of molybdenum trioxide (MoO_3) and the remainder is converted to ferromolybdenum. These products are sold to various customers primarily for high-end, metallurgical applications such as specialty (e.g., high temperature and high corrosion resistance) steel production (Finch 2007, IMOA 2007). Since 1989 (Minarik and Gillerman 1990) about 10 percent of the molybdenum concentrates are further purified and size classified at the mill to produce high performance molybdenum solid lubricants. The molybdenite in these lubricants can withstand high temperatures (> 212 °F) unlike petroleum-based fluid lubricants. These molybdenum lubricants typically work well up to 750 °F, or as high as 1,300 °F in dry, oxygen-free environments. The molybdenum lubricants also work well at high pressures (e.g., 50,000 psi) and, unlike graphite, work well in high vacuum conditions (Noria Corporation 2006).

The analysis area is in the southwest portion of the Bayhorse Mining District, which has been explored extensively since 1864. The mineral potential of the selected land was evaluated in detail by Gardner (2008). The mineral potential of the mine site would be the same apart from the known mineral value of molybdenum, all of which is on private land owned by TCMC. The following salable minerals occur on the selected land: fill, building stone, decorative rock, and construction aggregate (sand-size through riprap). The land has high potential for a variety of

[3] The mine is expected to have one such slowdown at the end of 2014 when the last of the Phase 7 ore has been processed but the Phase 8 ore will not be available (Challis Messenger 2014, Thompson Creek Metals Company 2014).

additional salable minerals. However, the salable mineral value of the land is nominal, with little probability of any large-scale (e.g., 1,000,000 cubic yards) development for salable minerals in the foreseeable future (Gardner 2008).
The analysis area also contains scattered occurrences of calcite, pyrite, and varieties of quartz such as chalcedony, jasper, and opal. These minerals occur primarily in units of the Challis Volcanic Group, but also may occur in most any of the other rock types at the mine and selected land. These minerals are of general "rock hounding" interest, and some of the varieties of quartz (e.g., banded chalcedony "agate") in the region are of jewelry quality. However, these minerals occur typically as individual fragments a few inches or less in diameter scattered in alluvium, and no deposits of any size (e.g., hundreds of pounds) or of high-quality collection value are known in the locality (Gardner 2008).

There are no known leasable minerals within the analysis area, but the land is prospectively valuable for geothermal resources (high potential), and has low to no potential for all other leasable minerals. However, the potential value of geothermal resources within the analysis area is relatively small. In addition, most of the lands in the region are prospectively valuable for geothermal resources. Therefore, the probability of exploration and development of geothermal resources at the subject land in the foreseeable future is remote, and there is no known leasable mineral value of the land (Gardner 2008).

There are no known locatable minerals at the selected land, but the land has moderate to high potential for the following locatable minerals: antimony, copper, gold, lead, molybdenum, silver, tin, tungsten, vanadium, and zinc (Fisher and Johnson 1995, Gardner 2008). The exploration potential of the selected land for locatable minerals (e.g., 5,140 acres in the Bayhorse mining district) is such that, if the land were privately owned, one or two companies could seek a lease in the foreseeable future to explore, with an option to extract discovered minerals. However, the value of such a lease would be approximately $10,000. Each year TCMC pays approximately $60,000 to the BLM to maintain approximately 500 lode, placer, and millsite mining claims on the selected land. The claims are maintained to provide support areas for the mine (millsite claims) or to prevent nuisance activities from affecting the mine operations. Therefore, the value of such claims is not derived from underlying geologic formations and the claims have no known mineral value. Consequently, the locatable mineral value is considered nominal. Despite the high potential of the land for some minerals, the land has no known mineral values and the potential for mineral discovery would not warrant exploration by the BLM as part of any land disposal action (Gardner 2008).

3.2.1.3. Physiography

The analysis area is in the southern portion of the Northern Rocky Mountains Physiographic Province. The province comprises northeastern Washington, western Montana, northern and central Idaho, and is composed of rugged mountains except for a region of basin-and-range (fault-block), structural overprinting beginning approximately 20 miles east of the mine with the Lost River Valley and the Lost River Mountains. Each physiographic province is a region in which all parts are similar in geologic structure and climate, and whose pattern of relief features or landforms differs substantially from that of adjacent regions.

The analysis area is in the southeastern portion of the East Salmon River Mountains with the White Cloud Peaks to the south of the Salmon River. The locality consists of rugged mountains deeply dissected by numerous, steep-sided valleys and canyons. Tributaries to the Salmon River have incised dendritic drainage patterns that generally trend north to south and east to west. The topography is extremely rugged and steep (e.g., slopes up to 75 % in places) with all aspects represented but no aspect dominant. There are abundant bedrock outcrops, narrow ridges, and deep, V-shaped valleys, and the ridges are capped by resistant volcanic rocks. Cliffs and rock towers are abundant on the drier and steeper hillsides.

Elevations in the MMPO area range from 5,780 feet at the confluence of Bruno and S. creeks to 9,282 feet at the top of the Buckskin drainage. Elevations at the selected land range from 5,750 feet on S. Creek at the southeast corner of the land to 8,460 feet along a northwest-trending ridge east of Cherry Creek at the south edge of the land.

3.2.1.4. Geotechnical Issues

The geotechnical issues for this FEIS are limited to the stability of mine structures such as fuel storage tanks, buildings, pit walls, the WRSFs, and TSF. Therefore, seismicity is discussed for only the MMPO area and not the selected or offered lands. In addition, only earthquake seismicity is discussed for the MMPO area because blasting has occurred regularly at the mine since 1980 with no damage to any mine structures (and no other structures are near the blasting areas, i.e., the pit).

The MMPO area is in the Central Idaho Seismic Zone (aka Centennial Tectonic Belt). The zone contains high levels of earthquake activity and at least six major faults, including the Lost River and Sawtooth faults in the region of the mine (IBHS 2009). There are also many smaller faults in the region, although most are no longer active. There have been 674 earthquakes (of $\geq$ moment magnitude [M_w] 3.0) in the region since 1973 (Table 3.2-1). The majority of the earthquake epicenters were concentrated 20 miles east of the mine in and around Round Valley (Challis) and associated with the Lost River fault. The earthquake with the greatest recorded M_w in the region was the Borah Peak earthquake in 1983 with M_w 6.9 (Table 3.2-1). The epicenter of the earthquake was 27 miles east-southeast of the mine, and the earthquake had a maximum Mercalli intensity of IX (violent) assigned on the basis of surface faulting (NEIC 2012). However, the maximum intensity at the mine was an intensity of VI; this intensity is characterized by an earthquake that can be "felt by all" and causes slight damage (IBHS 2009). Due to the distance of the mine from the epicenter, the mine experienced only limited ground shaking and some rocks rolling off the pit walls, with no damage to the WRSFs, TSF, fuel tanks, etc. (Doughty 2010b).

Table 3.2-1. Earthquakes of $M_w \geq 3.0$ within 100 mile radius of MMPO area.

M_w	Number
3.0 to < 4.0	594
4.0 to < 5.0	71
5.0 to < 6.0	8
6.0 to < 7.0	1
≥ 7.0	0

NEIC (2012); -114.528 longitude; 44.308 latitude; 1973 to 09 April 2012

The earliest site-specific analyses established a maximum credible earthquake of M_w 5.5 at the mine (VTN 1980b). More recently, highly detailed and site-specific geotechnical evaluations of the TSF through the end of Phase 8 established a maximum credible earthquake of M_w 6.5 (5,000 year return period) generating a peak ground acceleration of 30 percent of gravity near the mine (Golder 2007, KP 2013). These recent evaluations considered both the USGS method of determining earthquake probability and hazard and the site-specific methods by URS (2000), and concluded 1) the hazard in both methods at all return periods greater than 500 years is dominated by background seismicity and not earthquakes occurring on any proximal faults, and 2) the URS (2000) site-specific estimate of the maximum background earthquake of M_w 6.5 is more reasonable than the USGS estimate of a single maximum background earthquake of M_w 7.0 for the entire Rocky Mountain region (Peterson et al. 2008). Similar rigorous geotechnical evaluations of the WRSFs used the same seismic values (BGC 2011, KP 2011a). In addition, geotechnical evaluations of the pit walls, including through Phase 8, were also recently completed (CNI 2011, KP 2011b).

3.2.1.5. Paleontological Resources

The rocks in the analysis area with the potential to contain meaningful paleontological resources are the Ella Dolomite, Saturday Mountain Formation, and Salmon River Assemblage. The only meaningful paleontological resource known in the analysis area is the graptolite and trilobite assemblage at the mouth of Bruno Creek (AGI 2012, VTN 1980b). The Bruno Creek access road was re-routed to avoid the fossil outcrop during development of the mine in the early 1980s. At that time the outcrop was considered to have potential paleontological value because 1) the fossils were the best preserved in the region, 2) trilobite and graptolite fossils are not commonly found together, and 3) the outcrop might yield additional information on graptolite and trilobite evolutionary history and ecology as well as on the geologic history of the region (VTN 1980b). However, because the site has been collected, studies of the collected fossils have been published, the fossils deposited in the American Museum of Natural History in New York (Churkin 1963), and the outcrop has not been studied in the 50 years since Churkin (1963), there is no longer any need for special protection for the site (Foss 2011).

During the extensive evaluations in the 1970s of cultural resources at the proposed mine site additional fossiliferous sites were located but due to poor preservation were deemed of "little scientific value" (VTN 1980b, p. 5). The entire locality of the mine, including the selected land, was extensively explored by geologists during the 1960s to present times; these exploration reports did not include descriptions of any obviously meaningful fossils (e.g., any vertebrate

fossils or any well preserved invertebrate fossils) except for the graptolite and trilobite assemblage described above. No fossils are known to have been exposed during any of the mine operations. No thick ash (tuff) units occur which could host a petrified forest similar to that in the Malm Gulch area located approximately 7 miles to the northeast of the analysis areas. Therefore, the potential of discovering meaningful paleontological resources in the foreseeable future in the Ella Dolomite, Saturday Mountain Formation, or Salmon River Assemblage in the analysis areas is low.

3.2.2. Offered Lands - Broken Wing Ranch

3.2.2.1. Geology

The surficial geology of the Broken Wing Ranch is comprised primarily of Quaternary alluvial deposits with smaller amounts of Quaternary colluvial deposits along the bases of slopes. A large Quaternary landslide deposit occupies some of the eastern margins of the ranch. The western portion of the ranch is underlain by volcaniclastic and sedimentary rocks and mafic lava of the Eocene Challis Volcanic Group, the Ordovician Ramshorn Slate (mostly shale), and Cambrian to Ordovician Quartzite. There are also a number of outcrops of Cambrian to Ordovician Bayhorse Dolomite to the west of the ranch, as well as a variety of faults. A fault is mapped extending south into BWR-1, and another fault is mapped at the southwest corner of the ranch (Fisher and Johnson 1995). The rocks in the locality have ample exposure due to abundant cliffs (i.e., differential erosion due to the varied rock types) and sparse vegetation.

3.2.2.2. Minerals

Any portions of the Broken Wing Ranch acquired by the US would comprise both the surface and mineral estates. If acquired by exchange, the mineral estate would become open to mineral entry 90 days following acceptance of title by the US pursuant to 43 CFR 2201.9(b). However, due to the only nominal known mineral value of the ranch and the BLM management goals for the ranch, the BLM might acquire the mineral estate by donation from TCMC. The mineral estate in such case would become open to mineral entry only if the BLM were to publish an order in the Federal Register opening the estate to mineral entry (43 CFR 2091.8), and the BLM would not intend to publish such an order in the foreseeable future. The bed of the Salmon River up to the ordinary high water mark is owned by the State of Idaho. The ranch is at the western edge of the Bayhorse Mining District.

Salable minerals occur on the ranch including fill, building stone, decorative rock (including river rock), and construction aggregate (sand-size through riprap). Quartzite talus has been sold in the past from below a cliff in the southwest area of the ranch. The talus was sold for $10 per ton and was used as building stone and decorative rock. There is approximately 50,000 tons of quartzite talus remaining at the site but the market for this material is likely less than 50 tons per year (Gardner 2012a). The larger (> 3 feet in diameter) quartzite blocks could be sold for approximately $5 to $15 per ton for riprap, but blocks of this size are limited. The values of other salable minerals at the ranch would be approximately $1 per cubic yard. In general, the salable mineral value of the land is nominal, and there is little probability of any large-scale (e.g., 1,000,000 cubic yards) development of the land for salable minerals in the foreseeable future. The land also likely contains scattered occurrences of small quantities of calcite, pyrite, and

varieties of quartz such as chalcedony, jasper, and opal of general "rock hounding" interest (Gardner 2012a).

The ranch is prospectively valuable for geothermal resources (high potential), and has low to no potential for all other leasable minerals. However, the potential value of geothermal resources is relatively small. In addition, most of the lands in the region are prospectively valuable for geothermal resources. Therefore, the probability of exploration and development of geothermal resources at the ranch in the foreseeable future is remote, and there is no known leasable mineral value (apart from nominal lease rates of $40/acre) (Gardner 2012a).

There is low to no potential for all plausible locatable mineral deposits on the Broken Wing Ranch (Fisher and Johnson 1995). In addition, the locality has been extensively explored such that any mineral deposit exposed at the surface has been prospected. There is no known locatable mineral value at the ranch, and the probability of discovering a valuable locatable mineral deposit is remote (Gardner 2012a).

3.2.2.3. Physiography

The Broken Wing Ranch is in the Northern Rocky Mountain Physiographic Province. However, in contrast to the rugged land of the mine and selected land in the East Salmon River Mountains, the ranch primarily occupies a narrow swath of land on the valley floor at the margin of the East Salmon River Mountains to the east, and the Boulder Mountains to the west. The ranch is approximately 3 miles in length, aligned generally north to south, and straddles the Salmon River. Elevations at the ranch range from 5,260 feet along the Salmon River at the north end of the ranch, to 6,200 feet at the southwest corner of BWR-1, with most of the ranch at an elevation of approximately 5,300 feet. The majority of the ranch is relatively flat, river bottom land. However, portions of the western area of the ranch are in foothills to the East Salmon River Mountains. These portions of the ranch are steep (e.g., slopes up to 75 %) with dominantly eastern aspects, and some northern and southern aspects along Lyon Creek.

3.2.2.4. Paleontological Resources

The only fossiliferous formation at the ranch is the Ordovician Ramshorn Slate. A small area of the Ramshorn Slate (mostly shale) occurs at the westernmost portion of BWR-1. In other areas the formation has produced crustaceans, graptolites, and sponge spicules (Digital Atlas of Idaho 2012). The most probable paleontological resources to be discovered at the ranch would be invertebrate plant fossils and petrified wood in the Eocene volcaniclastic and sedimentary rocks. However, no paleontological resources are known at the ranch and the probability that any meaningful paleontological resources would be discovered at the ranch in the foreseeable future is low.

3.2.3. Offered Lands - Garden Creek Property

3.2.3.1. Geology

The northern two-thirds of the property are overlain by large angular blocks of Quaternary talus at the base of cliffs and steep hillsides. The talus appears to overlie one or more members of the Late Proterozoic Pocatello Formation. The southwest portion of the property comprises the undifferentiated Miocene to Pliocene Salt Lake Formation. The southeast corner of the property

comprises undifferentiated Middle Cambrian Blacksmith and Bancroft limestones (Platt 1998). There are no major faults mapped within 3 miles of the property (Bond and Wood 1978).

3.2.3.2. Minerals

Any portion of the Garden Creek property acquired by the US would comprise both the surface and mineral estates. The status of the mineral estate would be the same as that of the Broken Wing Ranch, i.e., open to mineral entry 90 days following acceptance of title by the US in a land exchange or closed to mineral entry if the mineral estate were acquired as a donation (Section 3.2.2.2). The property is near the southwest margin of the district known historically for copper and gold. The Fort Hall Mining District has been explored extensively and has numerous prospects, two mines (Marsh Queen and Moonlight) with limited production, and several rock quarries. The property is not in any known oil shale, tar sand, or coal field; is not in any favorable exploration areas of the Western Phosphate Field; and is not in any known geothermal resource area or mineral development interest area.

The property has not been evaluated in detail for mineral potential, but likely has salable minerals suitable for fill or construction aggregate (Gardner 2012a). However, the isolated location of the property and the probable nominal value of such minerals preclude their development, i.e., the property probably has no known salable mineral value. The probability of exploration and development of geothermal or oil and gas resources at the property in the foreseeable future is low, and there is likely no known leasable mineral value at the land (apart from nominal lease rates of $40/acre) (Gardner 2012a). The property might have greater than low potential for some of the metals and industrial minerals (e.g., aluminum clay and silica) known in the Fort Hall Mining District, but probably has no known locatable mineral value. The probability of discovering a valuable locatable mineral deposit at the property is remote (Gardner 2012a).

3.2.3.3. Physiography

The Garden Creek property is in the northeastern portion of the Basin and Range Physiographic Province (Great Basin Section), bounded by the Columbia Plateau Physiographic Province (Snake River Plain Section) to the north, and the Middle Rocky Mountains Physiographic Province (Middle Rocky Mountains Section) to the east. The property is in the northern portion of the Bannock Range in an area of rolling hills. Elevations at the property range from 6,765 feet on the northwest boundary to 7,135 feet at the southeast corner, and the topography slopes overall to the west at 15 to 35 degrees.

3.2.3.4. Paleontological Resources

The only fossiliferous formation at the property is the Miocene to Pliocene Salt Lake Formation, of which some members have yielded rare vertebrate and invertebrate fossils which have been extensively studied since at least the 1940s (Digital Atlas of Idaho 2012). No paleontological resources are known at the property (AGI 2012), and there is a very low potential of discovering meaningful paleontological resources at the property.

3.3. Soil Resources

The analysis area for soil resources for the MMPO alternatives is the surface disturbance associated with the MMPO alternatives. The analysis area for the land disposal alternatives is the selected and offered lands.

3.3.1. MMPO Area and Selected Land

The analysis area is characterized by moderate (20 to 40 %) to very steep (40 to 80 %) slopes, dissected mountain slopes with vegetation ranging from forest, mixed forest, and grassland to bare slopes and rock outcrops. Limited soil occurs on upland benches (5 to 20 % slopes). Mountain and hillside soils are formed in weathered residuum and mixed colluvium, derived mostly from rocks of the Challis Volcanic Group, and to a lesser extent, Paleozoic sedimentary rocks. Soil along some minor and major drainages in the analysis area is formed in mixed alluvium.

Soil on the moderate to steep slopes, as well as slopes with northern aspects, tends to be somewhat deeper and support more coniferous vegetation, relative to soil on the steepest slopes and those with other aspects. Overall, soil depths range from very shallow to very deep, with shallow soil associated with bedrock outcrops and rock rubble. The fine fraction of surface soil horizons has textures between silt loam to sandy loam. Subsoil textures range between sandy clay loams and loamy sands. The content of coarse fragments, consisting of weathered bedrock, colluvium and/or alluvium, ranges between approximately 10 to 80 percent, with many soils, particularly those on steeper slopes, having greater than 40 percent coarse fragments throughout the soil profile. Soil series textures are mostly loamy-skeletal with some minor clayey-skeletal soils. These textures, in conjunction with moderately steep to very steep topography, result in well drained soils with a moderate to severe potential for water erosion across the analysis area.

3.3.1.1. MMPO Area

A Cryoll-Rubble Land-Rock Outcrop complex is the predominant soil map unit associated with the potential expansion areas of the Pat Hughes and No Name (Alternative M3 only) WRSFs (Figure 3.3-1). A similar Forest Service mapped soil (VF21) comprises the majority of the proposed expansion area of the Buckskin WRSF. These two map units typify the characteristics of soils found on the steeper slopes. The soils are shallow to moderately deep, often adjacent to bedrock and/or talus slopes, well drained, and have a high to severe erosion potential.

The Ezbin-Zeebar-Nielsen complex also occurs in the southeast portion of the potential expansion area of the Pat Hughes WRSF. These soils have a loamy-skeletal texture and share a similar physiographic position with the Lag Very Cobbly loam soils, but occur on somewhat gentler slopes. Ezbin-Zeebar-Nielsen soils are very deep to shallow (Nielsen soil), well drained, and have a moderate potential for water erosion.

The Klug, Low Precipitation-Povey complex occurs on steep, dry, bare- to grass-covered slopes with a southerly aspect in the potential expansion areas of the Pat Hughes and No Name WRSFs. These soils are very deep and well drained with loamy-skeletal texture and severe potential for water erosion.

The Lemco-Friedman complex is south of the TSF on moderate to steep slopes. These soils are on slopes of varying aspect and forest cover. The soils have a clayey-skeletal texture, are very deep, well drained, and have a moderate potential for water erosion.

Soils on the east side of the TSF (Map Units V26 and V28) are similar to the soils of the Cryoll-Rubble Land-Rock Outcrop complex described above. Soils on the west side of the facility (VF43) are moderately deep to deep with a loamy-skeletal texture. The majority of the area along the western side of the facility comprises steep, easterly facing slopes similar to the physiographic setting of soils of the Ketchum complex, mapped southwest of the facility by the Natural Resources Conservation Service (NRCS). These soils are deep, have a loamy-skeletal texture, and are well drained with moderate potential for water erosion.

Soils in the proposed power line corridor (VF43, VF31, and VF03) occur on steep slopes, have a loamy-skeletal texture and range in depth from shallow to deep. The soils have a moderate to severe potential for water erosion. There are no mapped prime farmland or soil units classified as hydric soils in the MMPO area.

Soil for reclamation of the TSF would be excavated from a borrow pit just west of the TSF, and from a borrow pit southwest of the TSF embankment. Both areas contain very deep, clayey-skeletal soils of Lemco-Freidman complex. Soil and alluvial material (~ 8.5 acres) would also be salvaged for reclamation from the Pat Hughes WRSF as part of the construction of the underdrain for the facility.

3.3.1.2. Selected Land

A substantial portion of the selected land comprises the Cryoll-Rubble Land Outcrop complex (1,978 acres), Lemco-Friedman complex (806 acres), Lag Very Cobbly loam (739 acres), and Klug, Low Precipitation-Povey complex (546 acres). Smaller portions of the land are composed of soils of the Ketchum complex and Ezbin-Zeebar-Nielsen complex (Section 3.3.1.1.).

Rock-Outcrop and Rubble Land and a Cryept-Rubble Land-Rock Outcrop complex comprise 207 acres of the selected land. These units are similar to the Cryoll-Rubble Land Outcrop complex, occur on very steep slopes, are shallow to moderately deep, well drained, and have a severe potential for water erosion.

The Gany gravelly loam occurs on moderately steep to steep forested slopes with a northerly aspect in the eastern portion of the selected land. This soil is formed in colluvium derived from limestone and consequently the pH of the subsoil is alkaline. The soil is very deep, well drained, and has a moderate potential for water erosion. Together with the Lag Very Cobbly loams, these soils comprise 379 acres of the selected land.

Parkay-Nurkey complex soils occur on dry, bare to grass-covered slopes with a western aspect on the east side of S. Creek. These soils have a loamy-skeletal texture, are very deep, well drained, and have a moderate potential for water erosion. They comprise 33 acres of the selected land.

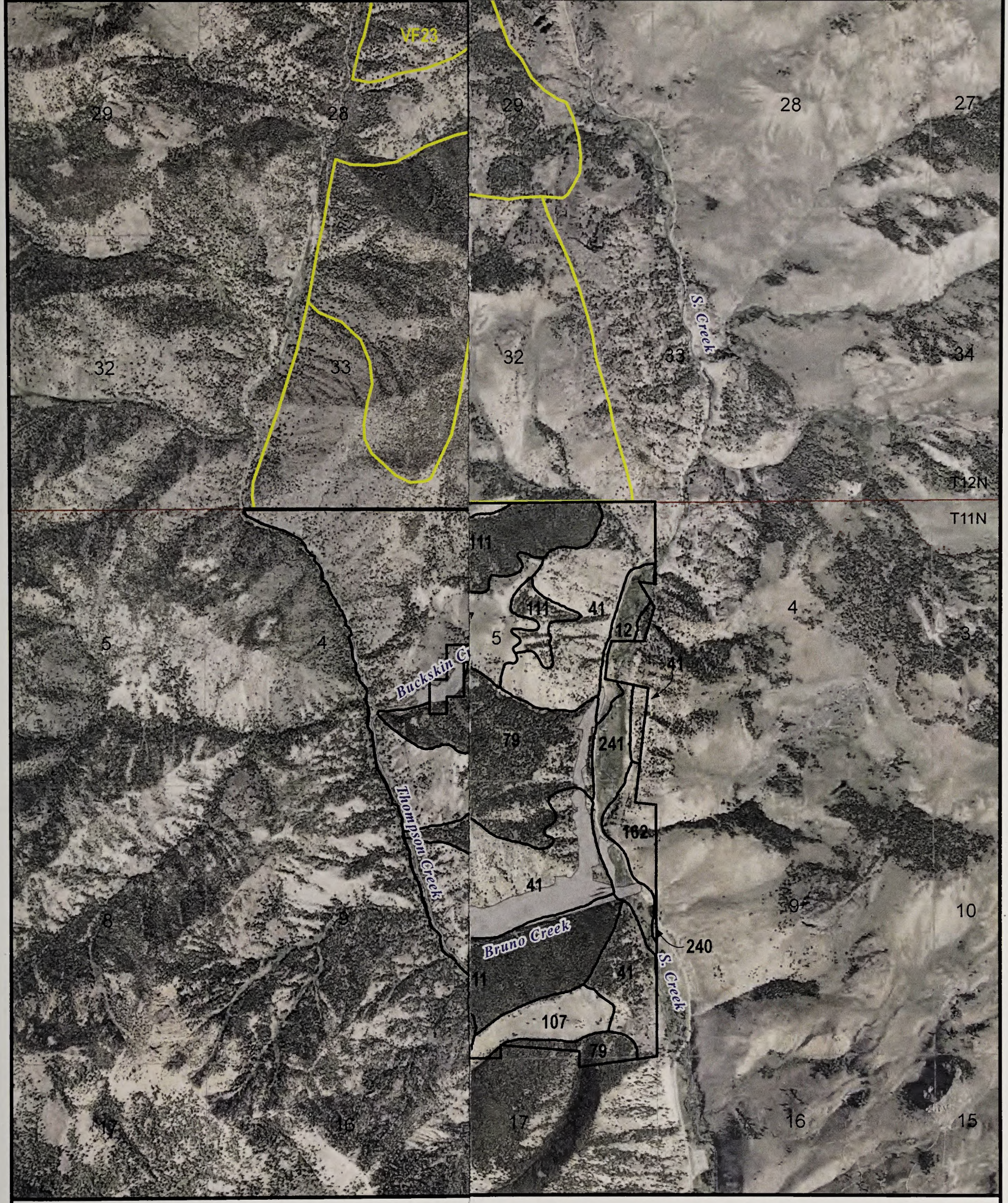
Soil complexes consisting of members of the Biglost, Copperbasin, and Wiskisprings series occur on the flat to gently sloping floodplain of S. Creek near the eastern border of the selected land. These soils formed in mixed alluvium and have silt loam to gravelly sandy loam texture. These soils are very deep, poorly to moderately well drained with low run-off, and a slight potential for water erosion. These soils comprise 77 acres of the selected land. There is no mapped prime farmland on the selected land. The Wiskisprings-Biglost and Wiskisprings-Biglost-Copperbasin complexes are classified as hydric soils.

3.3.2. Offered Lands – Broken Wing Ranch

The Broken Wing Ranch is characterized by flat to gentle slopes associated with the Salmon River floodplain and alluvial fan terraces that rise rapidly to steep, dissected hills to the east and west. Floodplain and fan terrace soils are utilized for irrigated and non-irrigated production of grass and alfalfa. The steeper slopes are dry and bare or a mixture of grass and sagebrush. Soil on the floodplains is relatively organic-rich, productive mollisols, or seasonally wet, poorly-drained aquepts and aquents. Soils at the ranch are mapped at a soil complex and soil association level (Figure 3.3-2). Parent material consists of mixed alluvium, colluvium, and residuum derived from the rocks of the Challis Volcanic Group and to a lesser extent Paleozoic sedimentary rocks to the west.

Soil at the ranch is most readily discussed by landform and physiographic position, as these factors, in conjunction with parent material, control soil development to a large extent. Floodplain and stream terrace soils (floodplain soils) were developed in mixed alluvium and colluvium, are very deep, and range in texture from silt loam to sandy loams, typically with a high gravel content in the subsoil. These soils are classified as fine-loamy to sandy-skeletal, are poorly to somewhat poorly drained, and have a slight potential for water erosion. Most of the area along Lyon Creek (52 acres) consists of Cryaquepts (moderately developed, seasonally wet soils). A large portion of the soil along the Salmon River (68 acres) is seasonally wet, carbonate-rich Calcic Cryaquolls and Aquic Haplocalcids of the Bigrant-Thosand-Dickeypeak complex. Minor soil types on floodplains (0 to 3 % slopes) generally have similar characteristics to those described above.

Soils on the gently sloping fan terraces is formed in mixed alluvium and colluvium deposited by tributary streams adjacent to the Salmon River floodplain, including Sink, Birch, Lyon, and Unnamed creeks. These soils are very deep with a somewhat coarser texture than the floodplain soils, ranging from sandy clay loams to loams with high coarse fragment subsoil horizons. Texture classes range from fine-loamy to loamy-skeletal. Some subsoil horizons are alkaline. These soils (385 acres of the ranch) are typically well drained and have a slight potential for water erosion due to their gentle slopes. The dry, well drained, carbonate-rich nature of soils on the fan terraces are typified by the three largest mapped soil units including Xeric Haplargids and Xeric Calciargids of the Pedoli-Dawtonia association (198 acres), the Whiteknob gravelly loam (71 acres), and the Sparmo-Zer complex (Xeric Haplocalcids). Minor soil types on fan terraces (1 to 8 % slopes) generally have similar characteristics to those described above.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Forest Service landtypes
- NRCS soils

Map Unit	Soil Name
12	Biglost-Copperbasin complex, 0-4% slopes
41	Cryolls-Rubble Land-Rock Outcrop complex,
42	Cryepts-Rubble Land-Rock Outcrop complex
62	Dumps, Mine
65	Ezbin-Zeebar-Nielsen complex, 20-50% slop
79	Gany gravelly loam, 30-60% slopes
103	Ketchum complex, 20-50% slopes
107	Klug, Low Precipitation-Povey complex, 25-

NOTE: Map Unit designations were manually ch
report dated 01/29/2008 as needed.

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Figure 3.3-1
Soil map, MMPO area and selected land
Thompson Creek Mine EIS

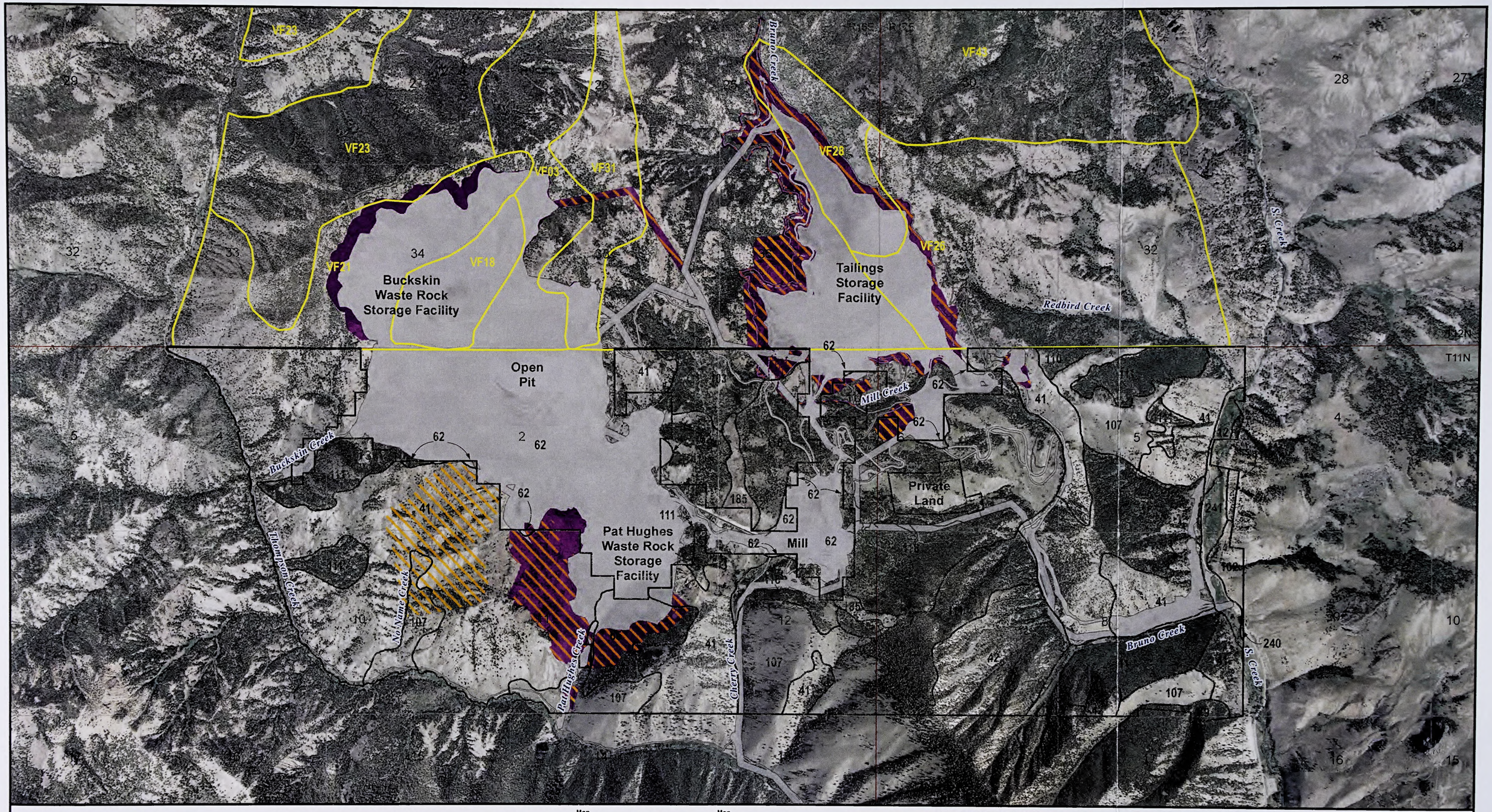
Soil complexes consisting of members of the Biglost, Copperbasin, and Wiskisprings series occur on the flat to gently sloping floodplain of S. Creek near the eastern border of the selected land. These soils formed in mixed alluvium and have silt loam to gravelly sandy loam texture. These soils are very deep, poorly to moderately well drained with low run-off, and a slight potential for water erosion. These soils comprise 77 acres of the selected land. There is no mapped prime farmland on the selected land. The Wiskisprings-Biglost and Wiskisprings-Biglost-Copperbasin complexes are classified as hydric soils.

3.3.2. Offered Lands – Broken Wing Ranch

The Broken Wing Ranch is characterized by flat to gentle slopes associated with the Salmon River floodplain and alluvial fan terraces that rise rapidly to steep, dissected hills to the east and west. Floodplain and fan terrace soils are utilized for irrigated and non-irrigated production of grass and alfalfa. The steeper slopes are dry and bare or a mixture of grass and sagebrush. Soil on the floodplains is relatively organic-rich, productive mollisols, or seasonally wet, poorly-drained aquepts and aquents. Soils at the ranch are mapped at a soil complex and soil association level (Figure 3.3-2). Parent material consists of mixed alluvium, colluvium, and residuum derived from the rocks of the Challis Volcanic Group and to a lesser extent Paleozoic sedimentary rocks to the west.

Soil at the ranch is most readily discussed by landform and physiographic position, as these factors, in conjunction with parent material, control soil development to a large extent. Floodplain and stream terrace soils (floodplain soils) were developed in mixed alluvium and colluvium, are very deep, and range in texture from silt loam to sandy loams, typically with a high gravel content in the subsoil. These soils are classified as fine-loamy to sandy-skeletal, are poorly to somewhat poorly drained, and have a slight potential for water erosion. Most of the area along Lyon Creek (52 acres) consists of Cryaquepts (moderately developed, seasonally wet soils). A large portion of the soil along the Salmon River (68 acres) is seasonally wet, carbonate-rich Calcic Cryaquolls and Aquic Haplocalcids of the Bigrant-Thosand-Dickeypeak complex. Minor soil types on floodplains (0 to 3 % slopes) generally have similar characteristics to those described above.

Soils on the gently sloping fan terraces is formed in mixed alluvium and colluvium deposited by tributary streams adjacent to the Salmon River floodplain, including Sink, Birch, Lyon, and Unnamed creeks. These soils are very deep with a somewhat coarser texture than the floodplain soils, ranging from sandy clay loams to loams with high coarse fragment subsoil horizons. Texture classes range from fine-loamy to loamy-skeletal. Some subsoil horizons are alkaline. These soils (385 acres of the ranch) are typically well drained and have a slight potential for water erosion due to their gentle slopes. The dry, well drained, carbonate-rich nature of soils on the fan terraces are typified by the three largest mapped soil units including Xeric Haplargids and Xeric Calciargids of the Pedoli-Dawtonia association (198 acres), the Whiteknob gravelly loam (71 acres), and the Sparmo-Zer complex (Xeric Haplocalcids). Minor soil types on fan terraces (1 to 8 % slopes) generally have similar characteristics to those described above.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Forest Service landtypes
- NRCS soils

Map Unit	Soil Name
12	Biglost-Copperbasin complex, 0-4% slopes
41	Cryolls-Rubble Land-Rock Outcrop complex, 50-80% slopes
42	Cryepts-Rubble Land-Rock Outcrop complex, 50-80% slopes
62	Dumps, Mine
65	Ezbin-Zeebar-Nielsen complex, 20-50% slopes
79	Gany gravelly loam, 30-60% slopes
103	Ketchum complex, 20-50% slopes
107	Klug, Low Precipitation-Povey complex, 25-60% slopes
110	Lag very cobbly loam, 20-40% slopes
111	Lag very cobbly loam, 40-70% slopes
118	Lemco-Friedman complex, 20-50% slopes
162	Parkay-Nurkey complex, 20-50% slopes
185	Rock Outcrop & Rubble Land, very steep
240	Wiskisprings-Biglost complex, 0-3% slopes
241	Wiskisprings-Biglost-Copperbasin complex, 0-3% slopes

NOTE: Map Unit designations were manually changed to correspond with Unit designations listed in NRCS Physical Soil Properties report dated 01/29/2008 as needed.

Map Unit	Landtype
VF03	Steep Headlands -Timbered; Moderately Deep-Loamy-Skeletal Soils, 46-66% slopes
VF21	Moderately Dissected Mountain Slopelands; Shallow to Moderately Deep-Loamy to Sandy-Skeletal Soils, 30-80% slopes
VF23	Moderately Dissected Mountain Slopelands-Timbered; Shallow to Deep-Loamy-Skeletal and Sandy-Skeletal Soils, 45-80% slopes
VF26	Strongly Dissected Mountain Slopelands; Shallow to Deep-Loamy-Skeletal to Sandy-Skeletal Soils; 40-70% slopes
VF28	Strongly Dissected Mountain Slopelands-Timbered; Moderately Deep to Deep-Loamy to Sandy-Skeletal Soils, 40-65% slopes
VF31	Fluvial Ridgeland--Rocky; Shallow-Loamy to Loamy-Skeletal Soils, 40-70% slopes
VF43	Unstable Fluvial Slopes--Timbered; Moderately Deep to Deep-Loamy to Loamy- Skeletal Soils, 21-65% slopes

Note: VF18 falls withthin the existing disturbance and is no longer applicable.

Soils data from NRCS SSURGO database.
Landtype data from USFS.
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

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No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.3-1
Soil map, MMPO area and selected land
Thompson Creek Mine EIS

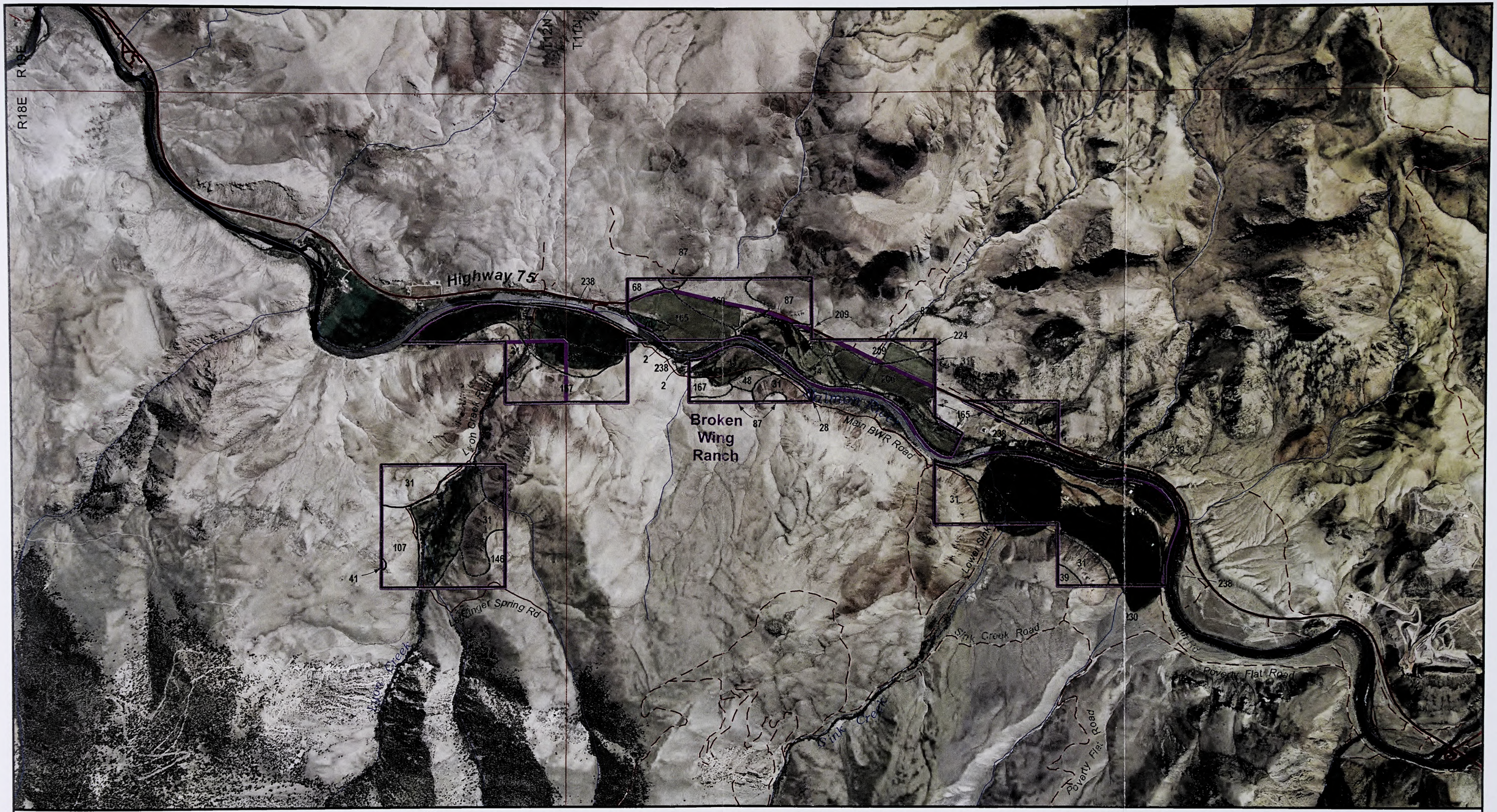


Legend

- Broken Wing Ranch NEPA parcels
- NRCS Soils
- Main Broken Wing Ranch Access
- 2WD road (Highway 75)
- Primitive road
- Stream

Map Unit	Soil Name
2	Aquents-Riverwash complex, ne
14	Bigrant-Thosand-Dickeypeak co
28	Bursteadt-Tohobit complex, 0-3
31	Calcids-Rubble Land-Rock Outc
37	Cowbone-Tohobit complex, 0-3
39	Crónks-Venum assoication, 6-2
41	Cryolls-Rubble Land-Rock Outc
48	Dawtonia Gravelly Loam, 4-8%
68	Farvant-Badland-Gradco compl
70	Fezip-Lemroi-Redfish complex,
87	Gradco-Farvant complex, 15-30

Figure 3.3-2
Soil map, Broken Wing Ranch
Thompson Creek Mine EIS



Legend

- Broken Wing Ranch NEPA parcels
- NRCS Soils
- Main Broken Wing Ranch Access
- 2WD road (Highway 75)
- Primitive road
- Stream

Map Unit	Soil Name
2	Aquents-Riverwash complex, nearly level
14	Bigrant-Thosand-Dickeypeak complex, 0-4% slopes
28	Bursteadt-Tohobit complex, 0-3% slopes
31	Calcids-Rubble Land-Rock Outcrop complex, 50-80% slopes
37	Cowbone-Tohobit complex, 0-3% slopes
39	Cronks-Venum assoication, 6-20% slopes
41	Cryolls-Rubble Land-Rock Outcrop complex, 50-80% slopes
48	Dawtonia Gravelly Loam, 4-8% slopes
68	Farvant-Badland-Gradco complex, 25-60% slopes
70	Fezip-Lemroi-Redfish complex, 0-2% slopes
87	Gradco-Farvant complex, 15-30% slopes
107	Klug, Low Precipitation-Povey complex, 25-60% slopes
146	Nurkey-Dawtonia association, 20-55% slopes
165	Pedoll-Dawtonia copmlex, 1-4% slopes
167	Penagul-Rosebriar complex, 20-60% slopes
206	Sparmo-Zer complex, 1-5% slopes
209	Sprabat-Snowslide complex, 1-8% slopes
221	Typic Cryaquepts, 1-3% slopes
224	Venum-Rock Outcrop complex, 25-55% slopes
230	Whiteknob Gravelly Loam, 2-8% slopes
238	Wiskisprings-Biglost complex, 0-3% slopes
260	Zer-Snowslide complex, 5-25% slopes

Soils data from NRCS SSURGO database.
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

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Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.3-2
Soil map, Broken Wing Ranch
Thompson Creek Mine EIS



Legend

- Offered lands
- Primitive road
- Trail
- Stream

Map Unit	Soil Name
84,	Pavohroo-Sedgway-Toponce complex, 20 to 50 percent slopes
45,	Greys-Pavohroo-Sedgway association, 8 to 20 percent slopes

Soils data from NRCS SSURGO database.
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

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Meters

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.3-3
Soil map, Garden Creek property
Thompson Creek Mine EIS

Soils on the steeper hillsides and ridge tops on the ranch formed in mixed colluvium and residuum derived primarily from the Challis Volcanic Group rocks and ash. These soils (on 288 acres of the ranch) are well drained and soil depths range from very shallow on the steepest slopes to deep on somewhat gentler slopes. Soil textures range from clay loam to sandy loam with a high coarse fragment content (loamy skeletal). Water erosion potential ranges from moderate to severe. A complex of talus, rock outcrops, and dry carbonate-rich soils (calcids) comprises approximately half (138 acres) of the soils on the ranch. The clayey-skeletal Haplargids of the Penagul-Rosebriar complex (51 acres) and ashy-skeletal Haplocalcids of the Gradco-Farvant complex (38 acres) are representative of soils on the ranch. Other soils in this landscape position on the ranch share similar physical characteristics as those described above. There is no mapped prime farmland on the ranch, but hydric soil series at the ranch include Typic Cryaquents and series members of the Aquent-Riverwash, Cowbone-Tohobit, Fezip-Lemroi-Redfish and Wiskisprings-Biglost complexes.

Erosion rates from conventionally plowed agricultural fields (≈ 5 tons/acre/year) average 1 to 2 orders of magnitude greater than rates of erosion under natural vegetation (Montgomery 2007). However, erosion rates from the cultivated fields (dense, irrigated grass) at the ranch are relatively low (~ 0.2 tons/acre/year)[4] and would be comparable to typical rates of erosion under natural vegetation for moderate gradient hillslopes of soil-mantled terrain (≈ 0.2 tons/acre/year) (Montgomery 2007). An erosion rate of 0.2 tons per acre per year is an order of magnitude below the typical soil sustainability factors of 2 to 5 tons per acre per year for soils at the ranch (NRCS 2002a).

3.3.3. Offered Lands – Garden Creek Property

Two soil complexes are mapped on the property: the Pavohroo-Sedgway-Toponce complex, found on steeper mountainsides, and the Greys-Pavohroo-Sedgway association, found on mountain footslopes and hillsides (Figure 3.3-3). All of the soils of the two soil complexes are cryoborolls formed in loess, silty alluvium, and/or colluvium derived from loess and/or sedimentary and metasedimentary rocks. Soil textures are gravelly silt loams and silt loams, classified as fine montmorillonitic (clay) to loamy-skeletal. The soils are very deep and well drained. Run-off is rapid and the potential for water erosion is high to very high. The former comprises 75 acres (94 %) of the property. Dominant vegetation on the site consists of evergreen and mixed evergreen/aspen forest with a small forested riparian corridor. No prime farmland or hydric soil series are mapped on the property, although minor series inclusions of hydric soils may occur along stream terraces (Enochville Silt Loam and Enochville variant gravelly silt loam).

3.4. Vegetation, Forest Resources, and Invasive and Non-native Plants

The analysis area for vegetation, forest resources, and invasive and non-native plants ("weeds") for the MMPO alternatives is the surface disturbance associated with the alternatives. The analysis area for the land disposal alternatives is the selected and offered lands. Special status plant species are also summarized in this section. Special status plant species are those listed as proposed, candidate, threatened, or endangered under the ESA by the US Fish and Wildlife

[4] e.g., average slope ≈ 3 %, slope length ≈ 1,000 feet, Pedoli gravelly silt loam 50 %, Custer County precipitation Req_25-28, grass hay, two cuttings, aftermath grazing to 25 % stubble height (RUSLE2 2006)

Service (USFWS), or those listed as sensitive by either the BLM or Forest Service. There are no proposed, threatened, or endangered plant species in the analysis area. Whitebark pine (*Pinus albicaulis*) is the only candidate plant species that occurs in the analysis area. There are seven special status plant species that fall within the jurisdictions[5] associated with the analysis areas (Table 3.4-1).

Table 3.4-1. Special status plant jurisdiction, all analysis areas.

	MMPO Area	Selected Land	Broken Wing Ranch	Garden Creek Property
SPECIES **Common name** *Scientific name*	**BLM Challis Forest Service**	**BLM Challis**	**BLM Challis**	**BLM Pocatello**
Challis crazyweed *Oxytropis besseyi* var. *salmonensis*	Yes (BLM and Forest Service)	Yes	Yes	No
Challis milkvetch *Astragalus amblytropis*	Yes (BLM)	Yes	Yes	No
Idaho sedge *Carex idahoa*	No	No	No	Yes
Lemhi milkvetch *Astragalus aquilonius*	Yes (BLM and Forest Service)	Yes	Yes	No
Wavy-leaf thelypody *Thelypodium repandum*	Yes (BLM and Forest Service)	Yes	Yes	No
White eatonella *Eatonella nivia*	Yes (BLM)	Yes	Yes	No
Whitebark pine *Pinus albicaulis*	Yes (BLM and Forest Service)	Yes	No	No

3.4.1. MMPO Area and Selected Land

3.4.1.1. General Vegetation

The major vegetation cover types within the analysis area include upland forests of Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*); riparian forests of cottonwood (*Populus* spp.), aspen (*Populus tremuloides*), and tall shrubs; semi-desert shrublands of sagebrush (*Artemisia* spp.); perennial grasslands; and subalpine

[5] Each land management agency (Forest Service and BLM) maintains its own sensitive species list. There is some overlap between Forest Service and BLM (some species are designated as sensitive by both). Threatened, endangered, proposed, or candidate ESA species (USFWS jurisdiction) would be evaluated in all areas.

meadows. Evergreen forests occupy the majority of the area whereas semi-desert shrublands are the predominant non-forest vegetation cover. Transitional areas, where evergreen forests and semi-desert shrublands overlap, are most prevalent along the western quarter of the selected land where sagebrush shrubs mix with Douglas-fir trees.

Topography (elevation and aspect), historic fire cycles, fire suppression, infestations from mountain pine beetles (*Dendroctonus ponderosae*), western spruce budworm (*Choristoneura occidentalis*), dwarf mistletoe (*Arceuthobium douglasii*), and logging are the factors that interact with and influence successional vegetative processes in the analysis area. Human activities have affected portions of the area including the construction and improvement of roads for mine-related activities, mine facilities, reseeding old roads and disturbed areas with non-native grasses and forbs, fire suppression, and through weed invasion related to these activities.

Fire suppression in the SCNF has occurred since 1910 (BLM 1999). Between 1924 and 2009, four small wildfires (< 10 acres each) caused by lightning strikes have been documented on the selected land. In 1927, a large fire of greater than 100 acres occurred on forested land between the Lower Buckskin WRSF and the Pat Hughes WRSF (Pfeifer 2009, 2010). Post-fire vegetation consists mostly of lodgepole pine, Douglas-fir, sagebrush, and scattered aspen.

Most of the forest in the analysis area has not experienced the thinning and fuel-reducing benefits of non-lethal (i.e., not stand replacing) fires since settlement (pre-1900). Historically, dry Douglas-fir habitat types (e.g., Douglas-fir/mountain snowberry [*Symphoricarpos oreophilus*] and Douglas-fir/pinegrass [*Calamagrostis rubescens*]) typically burned with low-severity, non-lethal fires at least once every 35 years (Crane and Fischer 1986). Lodgepole pine communities were associated with surface fires that burned with low to medium severity every 25 to 50 years (Arno 1980). Subalpine fir habitat types burned with mixed severity fires at least once every 35 to 100 years. Mixed severity fires burn in a mosaic pattern with some areas of fire being non-lethal and other areas being stand-replacement. The longer intervals between fires allow fuel to build up to levels that create high-severity, stand-replacing fires (Crane and Fischer 1986).

In older forests (averaging > 150 years in age), Douglas-fir trees are considered the climax species (the species that will occupy a site in a steady state). In general, fire hazards due to overstocking are generally lower in older Douglas-fir forests at low to mid elevations because the sparser understory is limited by moisture. In contrast, near the confluence of Bruno and S. creeks, there is an area that burned less than 150 years ago and has regenerated into an overstocked, vigor-reducing condition that could fuel a stand-replacing fire or insect attack (BLM 1999).

Insect and disease infestations to forest resources were evaluated from 1999 to 2009 within a 4 mile radius of the analysis area by the SCNF Aerial Insect and Disease Detection Survey (USFS 2010). The Douglas-fir beetle was found to be fairly common on adjacent lands to the southwest and northeast, and the largest detections occurred in 2009. Light areas of defoliation (< 50 %) of Douglas-fir and spruce trees by the western spruce budworm were detected in 2009 across the eastern half of the selected land and along the northern property boundary between the TSF and the open pit (USFS 2010). Approximately 45 percent of lodgepole pine and 40 percent

of Douglas-fir stands in the SCNF are infected with dwarf mistletoe (BLM 1999). Dwarf mistletoe infestations also occur on trees throughout the analysis area.

Evidence of historic logging occurs on north- and east-facing slopes. On the steep and dry south- and west-facing slopes, logging is not practical. Areas at the mine have historically been logged (liquidation sales) prior to mine development. Between 2003 and 2004 a post and pole harvest sale (8 acres) occurred on the selected land (Baer 2009). Historically logged areas have regenerated mostly with lodgepole pine. Therefore, the reclamation tree seedlings will be lodgepole pine and may include seedlings grown from seeds collected from relatively high elevations and ecosystems similar to that of the pre-mine condition, i.e., preservation of genetic diversity and trees best adapted for local conditions.

3.4.1.2. Vegetation Cover Types

The following subsections describe the cover types and associated vegetation for the analysis area (Figure 3.4-1).

Grasslands

Grasslands cover 229.7 acres or 4 percent of the selected land and 5.3 acres of the MMPO area (Alternative M2) on BLM land. Grasslands refer herein to native, perennial grasslands; areas reclaimed and dominated by grasses with a minor component of woody plants and subalpine meadows.

Semi-Desert Shrublands

There are four cover types of semi-desert shrublands in the analysis area: mountain big sagebrush, Wyoming big sagebrush, low sagebrush, and mountain mahogany. Semi-desert shrublands cover 1,229.7 acres (24 %) of the selected land and 62 acres (13 %) of the MMPO area (Alternative M2) on BLM, Forest Service, and TCMC lands.

Riparian Shrubland

Riparian shrubland covers 48.8 acres (1 %) of the selected land and less than 0.1 acre of the MMPO area (Alternative M2) on BLM land. This cover type occupies the riparian zone where shrubs dominate the upper canopy. The larger stands of riparian shrubland occur in the S., Bruno, Thompson, and No Name drainages at the selected land. Commonly occurring shrub species include alder (*Alnus* spp.), willow (*Salix* spp.), and dogwood (*Cornus sericea*). Other associated species include chokecherry (*Prunus virginiana*), serviceberry (*Amelanchier* spp.), Woods' rose (*Rosa woodsii*), and currant (*Ribes* spp).

Evergreen Forests

There are six communities (all upland) in the evergreen forests cover type in the analysis area: Douglas-fir, Douglas-fir/lodgepole pine, lodgepole pine, subalpine fir, subalpine fir/whitebark pine, and mixed subalpine. Evergreen forests comprise 3,357.1 acres (65 %) of the vegetation at the selected land and 390.7 acres (76 %) of the vegetation at the MMPO area (Alternative M2) (BLM, Forest Service, and TCMC lands).



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

USFS Cover Types

1001	Barren
1004	Grass/Forb
2001	Spruce/Fir
2002	Whitebark Pine
2003	Douglas-fir
2009	Lodgepole Pine
3010	Bunchgrass/Fescue
3011	Fescue
5009	Mo
5010	Mo
5011	Co
5012	Fe
5019	Co
5020	Co

mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Coordinate system UTM Zone 11 NAD 83

Figure 3.4-1
Vegetation cover types, MMPO area and selected land Thompson Creek Mine EIS

of Douglas-fir stands in the SCNF are infected with dwarf mistletoe (BLM 1999). Dwarf mistletoe infestations also occur on trees throughout the analysis area.

Evidence of historic logging occurs on north- and east-facing slopes. On the steep and dry south- and west-facing slopes, logging is not practical. Areas at the mine have historically been logged (liquidation sales) prior to mine development. Between 2003 and 2004 a post and pole harvest sale (8 acres) occurred on the selected land (Baer 2009). Historically logged areas have regenerated mostly with lodgepole pine. Therefore, the reclamation tree seedlings will be lodgepole pine and may include seedlings grown from seeds collected from relatively high elevations and ecosystems similar to that of the pre-mine condition, i.e., preservation of genetic diversity and trees best adapted for local conditions.

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Semi-Desert Shrublands

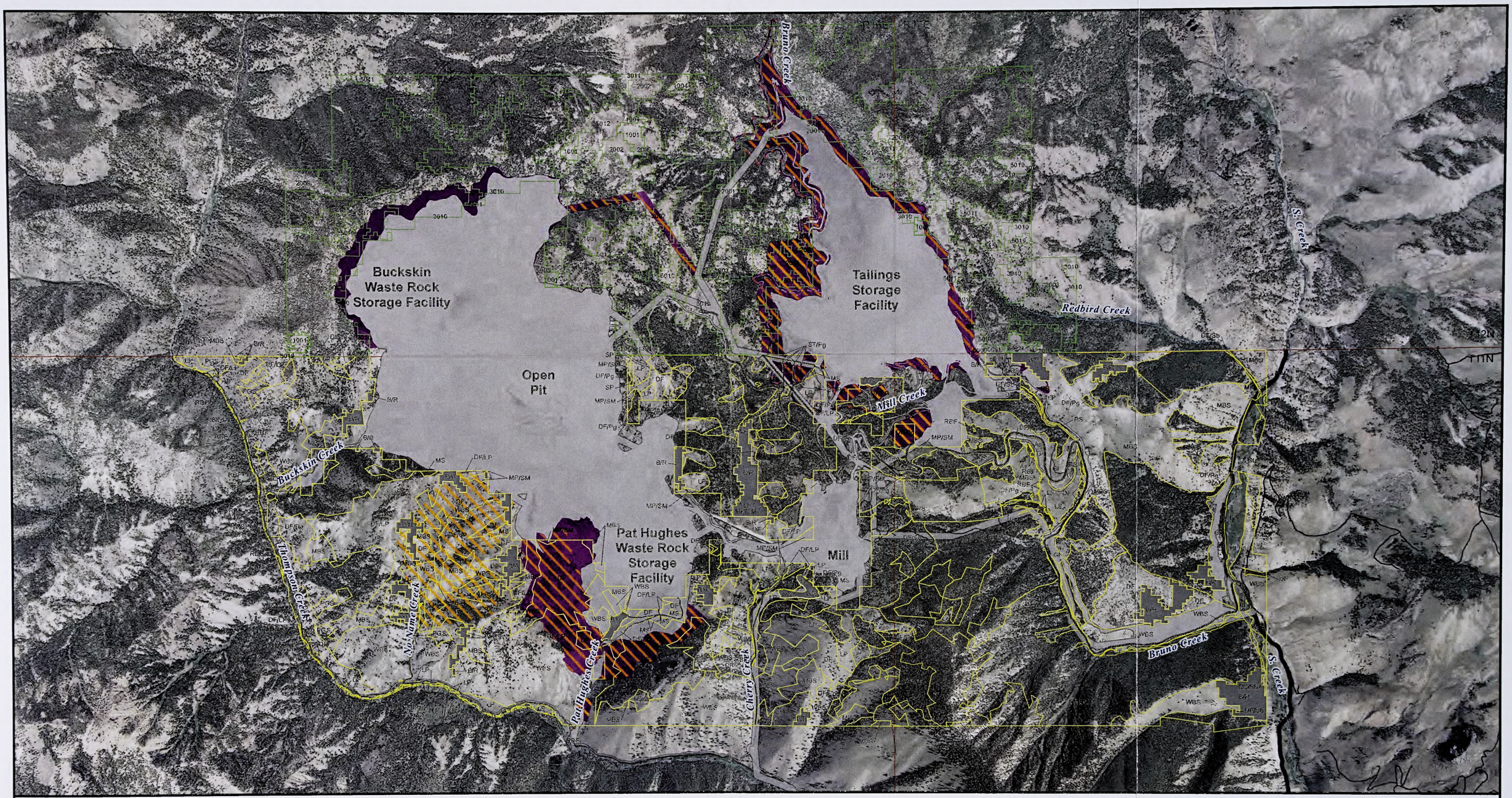
There are four cover types of semi-desert shrublands in the analysis area: mountain big sagebrush, Wyoming big sagebrush, low sagebrush, and mountain mahogany. Semi-desert shrublands cover 1,229.7 acres (24 %) of the selected land and 62 acres (13 %) of the MMPO area (Alternative M2) on BLM, Forest Service, and TCMC lands.

Riparian Shrubland

Riparian shrubland covers 48.8 acres (1 %) of the selected land and less than 0.1 acre of the MMPO area (Alternative M2) on BLM land. This cover type occupies the riparian zone where shrubs dominate the upper canopy. The larger stands of riparian shrubland occur in the S., Bruno, Thompson, and No Name drainages at the selected land. Commonly occurring shrub species include alder (*Alnus* spp.), willow (*Salix* spp.), and dogwood (*Cornus sericea*). Other associated species include chokecherry (*Prunus virginiana*), serviceberry (*Amelanchier* spp.), Woods' rose (*Rosa woodsii*), and currant (*Ribes* spp).

Evergreen Forests

There are six communities (all upland) in the evergreen forests cover type in the analysis area: Douglas-fir, Douglas-fir/lodgepole pine, lodgepole pine, subalpine fir, subalpine fir/whitebark pine, and mixed subalpine. Evergreen forests comprise 3,357.1 acres (65 %) of the vegetation at the selected land and 390.7 acres (76 %) of the vegetation at the MMPO area (Alternative M2) (BLM, Forest Service, and TCMC lands).



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

USFS Cover Types

1001	Barren
1004	Grass/Forb
2001	Spruce/Fir
2002	Whitebark Pine
2003	Douglas-fir
2009	Lodgepole Pine
3010	Bunchgrass/Fescue
3011	Fescue
5009	Mountain Big Sage
5010	Mountain Big Sage/Fescue
5011	Conifer/Mountain Big Sage
5012	Fescue/Conifer
5019	Conifer/Mountain Big Sage
5020	Conifer/Fescue

BLM Cover Types

As	Aspen
B/R	Barren/Rock
	Disturbed/Road
DF	Douglas-Fir
DF/LP	Douglas-Fir/Lodgepole Pine
DF/Pg	Douglas-Fir/Pinegrass
DF/Sb	Douglas-Fir/Snowberrry
GI	Grassland
LP	Lodgepole Pine
LS	Low Sagbrush
MBS	Mountain Big Sagebrush
MM	Mountain Mahogany
MP/SM	Montane Parkland/Subalpine Meadow
MS	Mixed Subalpine
PGS	Perennial Grass Slope
RBF	Riparian Broadleaf Forest
RS	Riparian Shrub
SF	Subalpine Fir
SF/Pg	Subalpine Fir/Pinegrass
SF/WP	Subalpine Fir/Whitebark Pine
SP	Subalpine Pine
WBS	Wyoming Big Sagebrush

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.4-1
Vegetation cover types, MMPO area and selected land
Thompson Creek Mine EIS

Deciduous Forest

Deciduous forest covers 22.5 acres (0.4 %) of the selected land. The cover type occurs in the riparian zone where trees dominate the upper canopy. Perennial streams such as S., Thompson, and Bruno creeks have a denser tree canopy and a wider riparian corridor. Intermittent streams often support a discontinuous riparian community where there are sections of thick tree cover, shrubs, and small trees, alternating with the absence of trees and shrubs. The most common deciduous tree species are black cottonwood (*Populus balsamifera*), aspen, and Pacific willow (*Salix lucida* spp. *lasiandra*). Small groves of aspen were also noted on the edges of talus slopes, in a historic burned area, and in disturbed areas. Engelmann spruce (*Picea engelmannii*) and subalpine fir also occur in the riparian zone.

Developed/Disturbed Land

Developed/disturbed[6] land comprises approximately 70 acres (1 %) of the selected land and less than 0.1 acre of the MMPO area on BLM land.

Natural Barren Areas/Rock

Natural barren areas/rock covers 197.5 acres (4 %) of the selected land and 22.5 acres (5 %) of the MMPO area (Alternative M2) on BLM and TCMC lands. This cover type includes areas with less than 5 percent cover of vegetation with exposed soil, rock outcrops, talus or scree slopes.

3.4.1.3. Forest Productivity

Five habitat types have been identified in the MMPO area for merchantable timber. The predominant habitat type is Douglas-fir/elk sedge with low to moderate (30 to 85 cubic feet/acre/year) timber productivity. The second largest habitat type is Douglas-fir/pinegrass with low (25 to 50 cubic feet/acre/year) to moderate (50 to 85 cubic feet/acre/year) timber productivity in the pinegrass habitat type. The Douglas-fir/mountain snowberry habitat type has very low to low (20 to 50 cubic feet/acre/year) timber productivity as these trees regenerate very sporadically. The subalpine fir/pinegrass and subalpine fir/elk sedge habitat types have low to moderate (30 to 75 cubic feet/acre/year) timber productivity (Steele et al. 1981).

Three habitat types have been identified within the selected land for merchantable timber. The predominant habitat type is Douglas-fir/mountain snowberry with very low to low timber productivity (20 to 50 cubic feet/acre/year) as the trees regenerate very sporadically. The second largest habitat type is Douglas-fir/pinegrass with low (25 to 50 cubic feet/acre/year) to moderate (50 to 85 cubic feet/acre/year) timber productivity. The third habitat type is subalpine fir/pinegrass with low to moderate (30 to 75 cubic feet/acre/year) timber productivity (Steele et al. 1981). The forested area of the selected land is divided into shallow and steep slopes, which would determine the harvest method (Table 3.4-2). The forested area of the MMPO area (Alternative M2) and selected land is also classified by production capability (Figure 3.4-2).

[6] roads, structures, ditch margins, equipment and material storage areas, areas of concentrated livestock use, etc.

Table 3.4-2. Forested area,[1] selected land.

Location	> 45 % Slope (acre)	< 45 % Slope (acre)	Total (acre)
Township 11N, Range 17E			
Parcel 1 (Section 5)	300	0	300
Parcel 2 (Section 6)	100	200	300
Parcel 12 (Section 7)	570	60	630
Parcel 13 (Section 8)	448	0	448
Township 11N, Range 16E			
Parcel 3 (Section 1)	0	300	300
Parcel 4 (Section 2)	124	0	124
Parcel 5 (Section 3)	50	0	50
Parcel 7 (Section 4)	257	0	257
Parcel 8 (Section 9)	74	0	74
Parcel 9 (Section 10)	200	0	200
Parcel 10 (Section 11)	200	0	200
Parcel 11 (Section 12)	120	100	220
TOTAL	**2,443**	**660**	**3,103**

[1] areas from Baer (2009) rounded to whole acres

Currently the commercial demand is low for wood products such as posts and poles (Baer 2009), but the Forest Service frequently receives requests from private individuals seeking post and pole material for noncommercial use (Chilton 2009). There also does not appear to be a market for any appreciable amount of timber (e.g., 500 mbf/year) as the nearest sawmills that would accept raw timber are more than 200 miles from the analysis area.[7] The selected land also lacks a road network sufficient for transporting harvested timber.

[7] e.g., Clearwater Forest Industries, Inc., Tamarack mill, New Meadows, Idaho (220 miles); Sun Mountain Lumber, Inc. (low value stud mill), Deer Lodge, Montana (240 miles); Pyramid Mountain Lumber, Inc., Seeley Lake, Montana (292 miles) (Gardner 2012b).



n Gardner.

Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

Timber Resources Stand/Habitat

- Douglas-Fir/Pinegrass
- Doughlas-Fir/Snowberry
- Subalpine-Firr/Pinegrass

Figure 3.4-2
Timber production, MMPO area and selected land
Thompson Creek Mine EIS

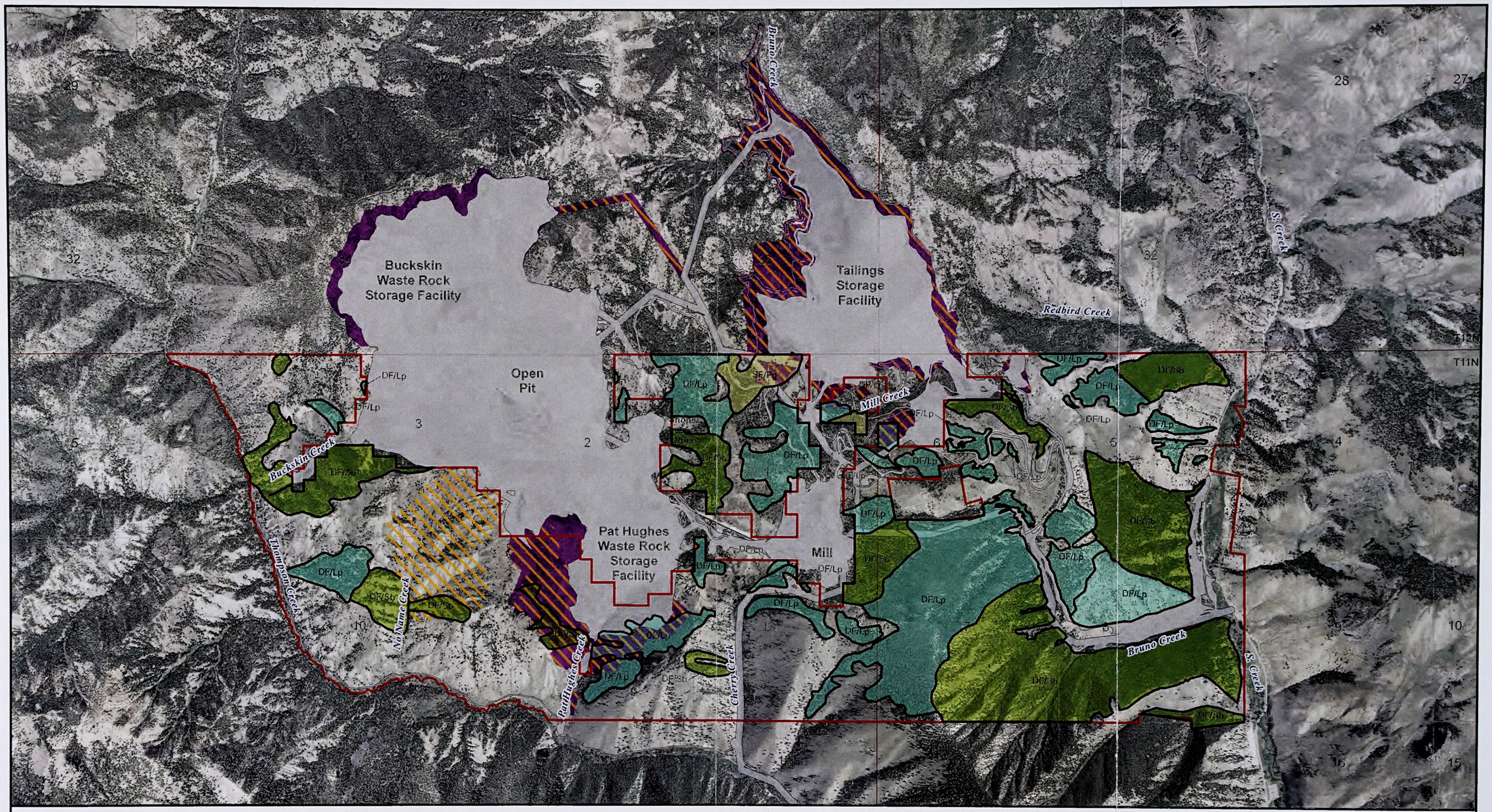
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Parcel 3 (Section 1)	0	300	300
Parcel 4 (Section 2)	124	0	124
Parcel 5 (Section 3)	50	0	50
Parcel 7 (Section 4)	257	0	257
Parcel 8 (Section 9)	74	0	74
Parcel 9 (Section 10)	200	0	200
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Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

Timber Resources Stand/Habitat

- Douglas-Fir/Pinegrass
- Doughlas-Fir/Snowberry
- Subalpine-Firr/Pinegrass

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
2009 NAIP imagery
Coordinate system UTM Zone 11 NAD 83

N

0 1:32,000 1
Miles

0 1
Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.4-2
Timber production, MMPO area and selected land
Thompson Creek Mine EIS

3.4.1.4. Old-Growth Forest

Although the definition of *old-growth* forest is complex and can vary according to the source, in general, old-growth forest is a stand of old, large diameter trees relatively undisturbed by humans. There is no old-growth forest in the analysis area. The subalpine fir/pinegrass habitat type (selected land) does contain a few scattered individuals of mature Douglas-fir that are approximately 24 inches in diameter. However, such habitat does not constitute old-growth habitat as defined by Green et al. (1992) and both the BLM and Forest Service believe that old-growth forest is unlikely in the analysis area (Baer 2009, Chilton 2009).

3.4.1.5. Invasive and Non-native Plants

Eight noxious weeds occur in the analysis area: Canada thistle (*Cirsium arvense*), sulphur cinquefoil (*Potentilla recta*), spotted knapweed (*Centaurea maculosa*), yellow toadflax (*Linaria vulgaris*), dalmation toadflax (*Linaria genistifolia* ssp. *dalmatica),* rush skeletonweed (*Chondrilla juncea*), houndstongue or gypsyflower (*Cynoglossum officinale*), and musk thistle (*Carduus* nutans) (Figure 3.4-3). The most prevalent species are spotted knapweed (80 acres) and yellow toadflax (52 acres) infestations (Gionet 2009). The remaining noxious weed infestations are minor (cumulatively < 1 acre). Noxious weeds are generally intermixed with native species and occur primarily along roads and in disturbed areas.

The Forest Service and BLM use a combination of Federal work force and contractors to perform noxious weed control and typically monitor their treatments for a year (Gionet 2009). The TCMC uses a contractor to implement weed control on the mine property, with follow-up site inspections.

3.4.1.6. Special Status Plant Species

Surveys to document the presence or absence of special status plant species in the analysis area have been limited. Therefore, the potential presence and distributions of most special status plant species in the analysis area is inferred from their presence in nearby areas and the presence in the analysis area of habitats where special status plant species are normally found. Incidental observations have verified the presence of some plant species (IDFG 2011a). Six special status plant species occur or may occur in the analysis area: Challis crazyweed, Challis milkvetch, Lemhi milkvetch, wavy-leafed thelypody, white eatonella, and whitebark pine. Suitable soils (Challis Volcanic Group) occur in much of the analysis area. However, the habitat around the mine is unoccupied by these species and there is no historical record of occurrence (IDFG 2011a). Most of the known locations for these species are clustered along the Salmon River or East Fork Salmon River (Section 3.4.2.4.). The elevation range of whitebark pine in Idaho is 7,300 feet to 10,500 feet (USFS 2013a). Whitebark pine could occur in the MMPO area and selected land as scattered individual trees (no stands) at the higher elevations on exposed ridges and in windswept areas. All of these special status plant species are sensitive species, and whitebark pine is also a candidate species under the ESA.

3.4.2. Offered Lands – Broken Wing Ranch

3.4.2.1. General Vegetation

The vegetation of the ranch is discussed by subparcel (Section 2.2.4., Figure 3.4-4). In the westernmost subparcel (BWR-1) vegetation communities transition from fingers of coniferous forests to grasslands and riparian forest surrounded by sagebrush hills. The eastern subparcels (BWR-2 through BWR-7) are adjacent to the Salmon River and contain areas of irrigated agricultural land, surrounded by xeric foothills dominated primarily by sagebrush and other low growing shrubs with small areas of grasslands. Species composition (apart from agricultural species) is dependent primarily on elevation, aspect, and substrate, all of which influence the temperature and moisture regimes under which plant communities have developed. Superimposed upon this pattern are the effects of land use, primarily grazing by domestic livestock and invasion by noxious weeds. Use of native rangeland by cattle tends to change community composition and dominance as a result of preferential consumption of some plant species, avoidance of other plant species, and direct and indirect effects from trampling and changes in moisture infiltration or run-off related to the lower and sparser cover.

3.4.2.2. Vegetation Cover Types

There are six general classifications of land cover and plant community types at the ranch: agriculture, semi-desert grassland, semi-desert shrubland, deciduous forest, mesic shrubland, and developed/disturbed areas.

Agriculture

Agricultural land covers 444.5 acres (53 %) of the ranch. Subparcels BWR-4 and BWR-6 have the largest agricultural areas of 150.6 and 144.7 acres, respectively. Agriculture land consists primarily of pasture and hay production including grasses, alfalfa, and mixtures planted for livestock grazing. Most of the agricultural land is irrigated and is on the valley floors adjacent to the Salmon River. These areas are characterized by gentle terrain, relatively deep loamy or gravelly loam soils (NRCS 2007), and availability of water for irrigation. Irrigation methods include the use of furrow or flood systems, wheel lines, and center pivot systems. Portions of the irrigated pastures contain herbaceous wetlands or areas dominated by hydrophytic vegetation (plants that thrive in wet conditions) (Section 3.9.).

Semi-Desert Grassland

Semi-desert grassland (perennial grass slopes) occurs on only BWR-1 and covers 9.5 acres (1 %) of the ranch. Grassland refers to areas dominated (> 50 % cover) by grasses and widely scattered shrubs. Grassland in the region comprise primarily native, drought resistant species such as bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), and Sandberg bluegrass (*Poa secunda*).

Semi-Desert Shrubland

Semi-desert shrubland covers 335.1 acres (40 %) of the ranch. All of the subparcels have at least one or more semi-desert shrubland vegetation communities with the largest areas of semi-desert shrubland on BWR-1 (107.6 acres), BWR-5 (76.8 acres), and BWR-6 (56.8 acres).

musk thistle
Carduus nutans

spotted knapweed
Centaurea maculosa

rush skeletonweed
Chondrilla juncea

yellow toadflax
Linaria vulgaris

sulphur cinquefoil
Potentilla recta

gypsyflower/houndstongue
Linaria vulgaris

yellow toadflax
Linaria vulgaris

spotted knapweed
Centaurea maculosa

dalmation toadflax
Linaria genistifolia ssp. dalmatica

Redbird Creek
Buckskin Ck
Thompson Creek
Bruno Creek
S. Creek
T12N
T11N

Legend

- Selected land
- MMPO areas/Alternative M3
- MMPO areas/Alternative M2
- Existing mining disturbance
- Stream

Noxious Weeds

Common name, Scientific name

- Canada thistle, Cirsium arvense
- yellow toadflax, Linaria vulgaris
- dalmation toadflax, Linaria genist

ta, polygons created by Ken Gardner.
State Office, Geographic Sciences.
S)

Figure 3.4-3
Noxious weed occurrences, selected land
Thompson Creek Mine EIS

3.4.2. Offered Lands – Broken Wing Ranch

3.4.2.1. General Vegetation

The vegetation of the ranch is discussed by subparcel (Section 2.2.4., Figure 3.4-4). In the westernmost subparcel (BWR-1) vegetation communities transition from fingers of coniferous forests to grasslands and riparian forest surrounded by sagebrush hills. The eastern subparcels (BWR-2 through BWR-7) are adjacent to the Salmon River and contain areas of irrigated agricultural land, surrounded by xeric foothills dominated primarily by sagebrush and other low growing shrubs with small areas of grasslands. Species composition (apart from agricultural species) is dependent primarily on elevation, aspect, and substrate, all of which influence the temperature and moisture regimes under which plant communities have developed. Superimposed upon this pattern are the effects of land use, primarily grazing by domestic livestock and invasion by noxious weeds. Use of native rangeland by cattle tends to change community composition and dominance as a result of preferential consumption of some plant species, avoidance of other plant species, and direct and indirect effects from trampling and changes in moisture infiltration or run-off related to the lower and sparser cover.

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Semi-Desert Shrubland

Semi-desert shrubland covers 335.1 acres (40 %) of the ranch. All of the subparcels have at least one or more semi-desert shrubland vegetation communities with the largest areas of semi-desert shrubland on BWR-1 (107.6 acres), BWR-5 (76.8 acres), and BWR-6 (56.8 acres).

Bruno Creek
S. Creek
Redbird Creek
Mill Creek
Buckskin Creek
Thompson Creek
No Name Creek
Pat Hughes Creek
Cherry Creek
Bruno Creek
S. Creek
T12N
T11N
34
Buckskin
Waste Rock
Storage Facility
Tailings
Storage
Facility
Open
Pit
Pat Hughes
Waste Rock
Storage
Facility
Mill
musk thistle
Carduus nutans
Canada thistle
Cirsium arvense
spotted knapweed
Centaurea maculosa
rush skeletonweed
Chondrilla juncea
yellow toadflax
Linaria vulgaris
gypsyflower/houndstongue
Cynoglossum officinale
sulphur cinquefoil
Potentilla recta
dalmation toadflax
Linaria genistifolia ssp. dalmatica

Legend

- Selected land
- MMPO areas/Alternative M3
- MMPO areas/Alternative M2
- Existing mining disturbance
- Stream

Noxious Weeds

Common name, Scientific name

- Canada thistle, Cirsium arvense
- yellow toadflax, Linaria vulgaris
- dalmation toadflax, Linaria genistifolia ssp. dalmatica
- gypsyflower/houndstongue, Cynoglossum officinale
- musk thistle, Carduus nutans
- rush skeletonweed, Chondrilla juncea
- spotted knapweed, Centaurea maculosa
- sulphur cinquefoil, Potentilla recta

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Noxious weed data from Natural Resource Information System (NRIS)
Coordinate system UTM Zone 11 NAD 83

N

0 1 1:32,000 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.4-3
Noxious weed occurrences, selected land
Thompson Creek Mine EIS



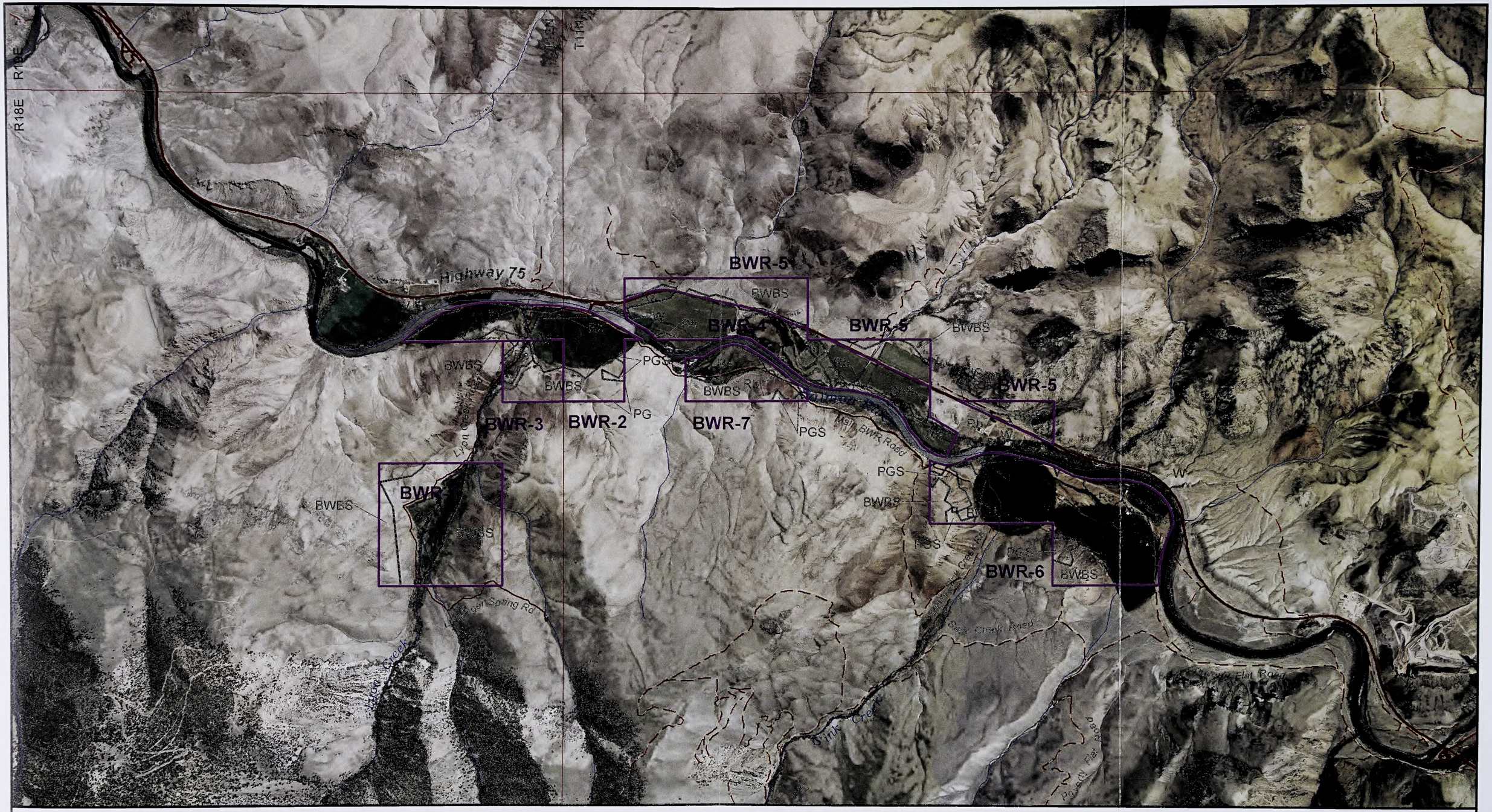
Legend

- Broken Wing Ranch NEPA parcels
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream

Vegetation

Map Label	Description
Ag	Agricultural
BWBS	Basin and Wyo
PG	Perennial grass
PGS	Perennial grass
Rb	Riparian - broad
Rs	Riparian - shrub

Figure 3.4-4
Vegetation cover types, Broken Wing Ranch
Thompson Creek Mine EIS



Legend

- Broken Wing Ranch NEPA parcels
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream

Vegetation

Map Label	Description	Map Label	Description
Ag	Agricultural	SdS	Salt-desert shrub
BWBS	Basin and Wyoming big sagebrush	W	Water
PG	Perennial grassland		
PGS	Perennial grass slope		
Rb	Riparian - broadleaf		
Rs	Riparian - shrub		

Vegetation from BLM
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

N

0 1:24,000 4,000
Feet

0 1
Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.4-4
Vegetation cover types, Broken Wing Ranch
Thompson Creek Mine EIS

Deciduous Forest

Deciduous forest covers 25.5 acres (3 %) of the ranch. All the subparcels have deciduous forest except BWR-5. Deciduous forest at the ranch consists primarily of black cottonwood, aspen, and various willow species. Canopy cover and tree density range from sparse to fairly dense. The composition of the understory is variable and most often controlled by the underlying soils. Deep loam soils tend to support a well-developed shrub layer whereas stony, coarser textured or shallow soils tend to support an herbaceous understory. Forested riparian corridors occur along Lyon Creek, large irrigation ditches, low banks, old oxbows, or on the outside bends of the Salmon River.

Riparian Shrubland

Riparian shrubland covers 6.8 acres (0.8 %) of the ranch and occurs on BWR-3, BWR-4, and BWR-7. Riparian shrubland corridors are generally found along irrigation ditches or drainages that are subject to seasonal overbank flows and along low banks or terraces of the Salmon River. The density of shrubs and width of the shrub corridor are greatest on the outside meanders of the Salmon River. Ditches and drainages often support a narrow and sometimes discontinuous riparian community, where there are alternating sections of thick tree cover, shrubs, small trees, and the absence of trees and shrubs. The most common shrub species is willow. Other species include alder, chokecherry, dogwood, serviceberry, Woods' rose, and currant.

Developed/Disturbed Land

Developed/disturbed land comprises approximately 20 acres (2 %) of the ranch and is found on BWR-3, BWR-4, BWR-5, and BWR-6. The largest areas are on BWR-4 (7.3 acres) and BWR-5 (8.2 acres). These areas typically contain several weed species (Section 3.4.2.3).

3.4.2.3. Invasive and Non-native Plants

In general, noxious weeds do not grow well in shaded environments (NDDA 2009). Four Idaho-listed noxious weeds occur at the ranch, particularly adjacent to roads, near water, and in agricultural fields on the ranch:

- Canada thistle: primarily occurs in the western parcel of the ranch as small isolated patches near or along Lyon Creek, along the upper road, and in transition areas between the Lyon Creek corridor and sagebrush slopes;
- Russian knapweed (*Acroptilon repens*): occurs as a small dense patch along the edge of the irrigated pasture in the far northern quarter of the ranch and is likely scattered in other locations across the ranch;
- Musk thistle: occurs in mesic (moderately moist) sites adjacent to Lyon Creek and associated wetlands in the western parcel of the ranch; and
- Oxeye daisy (*Leucanthemum vulgare*): occurs sparsely in mesic sites adjacent to Lyon Creek and associated wetlands in the western parcel of the ranch.

Eight other invasive weeds occur on disturbed/developed land at the ranch: clasping pepperweed (*Lepidium perfoliatum*), Russian thistle (*Salsolia iberica*), saltlover (*Halogeton glomeratus*), cheatgrass (*Bromus tectorum*), tumble mustard (*Sisymbrium altissimum*), tumble pigweed (*Amaranthus albaus*), kochia (*Kochia scoparia*), and common tansy (*Tanacetum vulgare*).

3.4.2.4. Special Status Plant Species

Six special status plant species may occur at the ranch (Table 3.4-3).

Table 3.4-3. Special status plant species, Broken Wing Ranch.

Species (Status)	Occurrence
Challis crazyweed (Sensitive)	**Likely** Suitable habitat occurs and there are historical records of the species near the ranch along the Salmon River (IDFG 2011a).
Challis milkvetch (Sensitive)	**Likely** Suitable habitat occurs and there are historical records of the species near the ranch along the Salmon River (IDFG 2011a).
Lemhi milkvetch (Sensitive)	**Likely** (Historically observed) Suitable habitat occurs and there are historical records of the species on the ranch (IDFG 2011a).
Wavy-leafed thelypody (Sensitive)	**Likely** Suitable habitat occurs and there are historical records of the species near the ranch along the Salmon River (IDFG 2011a).
White eatonella (Sensitive)	**Likely** (Historically observed) Suitable habitat occurs and there are historical records of the species on and northeast of the ranch (IDFG 2011a).
Whitebark pine (Sensitive)	**Not Present** Suitable habitat is not present on the ranch.

3.4.3. Offered Lands – Garden Creek Property

3.4.3.1. General Vegetation

The Garden Creek property is primarily forested land with a narrow riparian wetland bordering Garden Creek. Small, scattered patches of sagebrush and grassland also occur on and adjacent to the property. The tree canopy is composed of a mix of deciduous and coniferous species, co-dominated by aspen and Douglas-fir. The forest is uneven in age with various sizes of timber growth. A shrubby understory occurs underneath the forest layer.

3.4.3.2. Vegetation Cover Types

Four general vegetation types are found on the property: aspen, Douglas-fir, mixed conifer (evergreen), and deciduous (broadleaf) forest. A riparian/wetland corridor occurs along Garden Creek (Table 3.4-4).

Table 3.4-4. Vegetation cover types, Garden Creek property.

Cover Type[1]	Vegetation Community	Area[3] (acre)	(%)
FOREST			
Mixed evergreen deciduous	aspen/conifer mixed forest	15.1	18
Mixed evergreen deciduous	forested riparian corridor[2]	0.8	< 1
Evergreen	Douglas-fir	63.6	80
Deciduous	aspen	0.6	< 1
TOTAL		**80.1**	**100**

[1] BLM (2012b), Idaho Land Cover Classification System (2009)
[2] from Section 3.9.
[3] areas derived from GAP data

Broadleaf species such as Rocky Mountain maple (*Acer glabrum*) and willows are more abundant in moist forests, riparian areas, or along drainages. Common shrubs include snowberry, common juniper (*Juniperus communis*), Woods' rose, white spirea (*Spiraea betulifolia*), and creeping Oregon grape (*Mahonia repens*). Common grasses include pinegrass, Kentucky bluegrass (*Poa pratensis*), common timothy (*Phleum pratense*), blue wildrye (*Elymus glaucus*), bearded wildrye (*Elymus caninus*), and brome (*Bromus* spp.). Common forbs for this area include heartleaf arnica (*Arnica cordifolia*), western yarrow (*Achillea millefolium*), mountain sweet-cicely (*Osmorhiza chilensis*), Richardson's geranium (*Geranium richardsonii*), sticky geranium (*Geranium viscosissimum*), and elk sedge (*Carex garberi*) (Mueggler 1988).

3.4.3.3. Forest Health

In the previous 20 years, the Caribou-Targhee National Forest (CTNF) has no records of any major fires in the vicinity of the Garden Creek property and there is no evidence of historic fires. No insect or disease infestations or their related effects have been recorded in or near the property (Burts 2010).

3.4.3.4. Forest Productivity

The Pavohroo and Sedgeway soils on the property are well suited to the production of Douglas-fir. On the basis of a 50 year site curve, the average site index for Douglas-fir is 65 feet with a maximum average growth or potential yield of 85 cubic feet per acre per year at 40 years of age. Greys and Toponce soils are well suited to the production of aspen. On the basis of an 80 year site curve, the average site index for aspen is 65 feet with a maximum average growth or potential yield of 36 cubic feet per acre per year at 80 years of age. Most harvested aspen are used for firewood. No information was located on historic logging at the property, but tree stumps from selective tree removal range in size from "Christmas tree" to saw timber.

3.4.3.5. Invasive and Non-native Plants

Field inspections have not identified noxious weeds on the property. In addition, noxious weed infestations in the vicinity of the property are not known by the CTNF or the BLM Pocatello Field Office personnel (Burts 2010, Chipman 2010).

3.4.3.6. Special Status Plant Species

No surveys for special status plant species were made for the Garden Creek property. However, suitable habitat (riparian) for the Idaho sedge occurs on the property and thus, Idaho sedge could occur on the property.

3.5. Range Resources

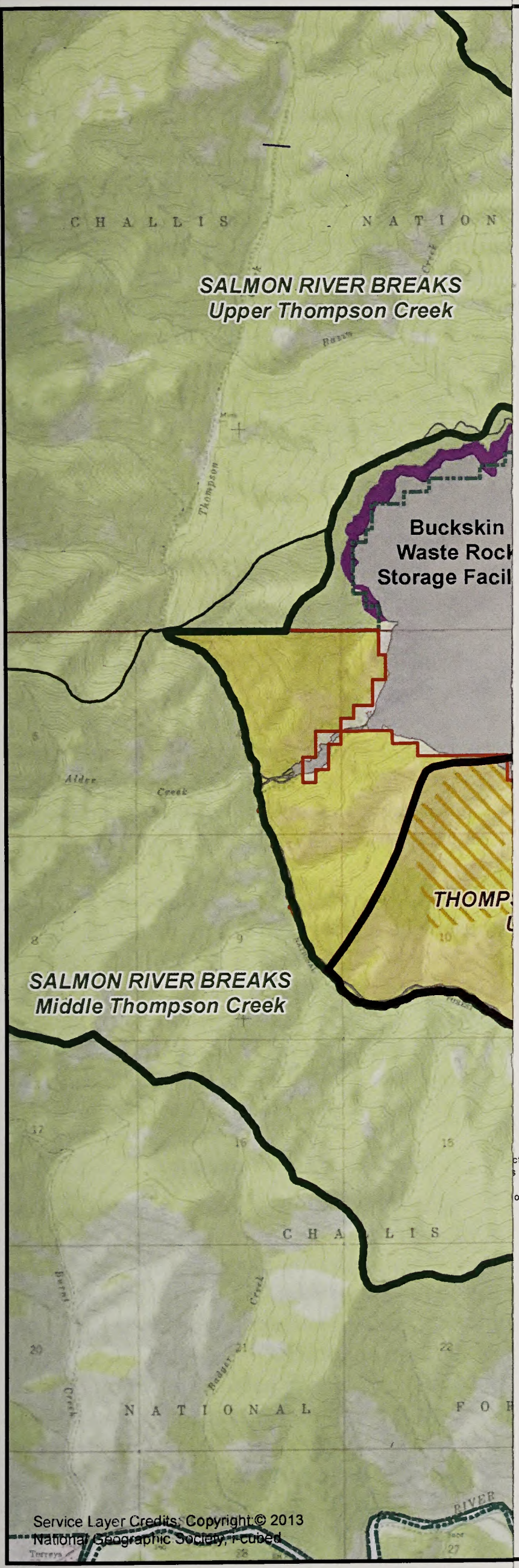
The analysis area for range resources for the MMPO alternatives is the portion of the BLM grazing allotments (S. Creek and Thompson Creek) containing the MMPO area. The analysis area for the land disposal alternatives is the selected and offered lands, and the area of the relevant land disposal provisions, i.e., the roads on private property for which the BLM would gain administrative access to the Saturday Mountain Pasture.

3.5.1. MMPO Area and Selected Land

The analysis area has historically been used for livestock grazing in an allotment system. Generally, cattle move through one or more allotments over a year, with part of the year spent on private land. The selected land includes portions of three pastures in the S. Creek Allotment and two pastures in the Thompson Creek Allotment (Figure 3.5-1).

South- and west-facing slopes above Thompson Creek are made up of rock outcrops and rubble lands, forest cover, and sagebrush-grasslands. Common species found on these slopes include Idaho fescue, bluebunch wheatgrass, blue wildrye (*Elymus glaucus*), mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*), other shrubs such as mountain snowberry (*Symphoricarpos oreophilus*), curl-leaf mountain mahogany (*Cercocarpus ledifolius*), and forbs such as heartleaf arnica, and arrowleaf balsamroot (*Balsamorhiza sagittata*). Patches of forest occur on north-facing slopes of side drainages; forested areas are mixed Douglas-fir, lodgepole pine, and subalpine fir. Forage production in an average year for this area ranges from near 0 pounds per acre at rock outcrops to about 490 pounds per acre on productive sagebrush-grass areas (NRCS 2007).

North- and east-facing slopes are mostly forested, with Douglas-fir and sub-alpine fir (*Abies lasiocarpa*) interspersed with mountain meadows. Forested areas provide much less forage than the grassy mountain meadows. These meadows support similar species to those noted above with the addition of mountain brome (*Bromus montanus*). Slopes are also steep in this area. Forage production in an average year for these forest-meadow mosaic areas ranges from near 0 pounds per acre in thick forest to approximately 490 pounds per acre in meadows (NRCS 2007).



Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

BLM allotments, pastures, and range improvements

- BLM allotment
- BLM pasture
- Spring
- Trough
- Pipeline

Forest Service allotments, pastures, and range improvements

- Forest Service allotment
- Forest Service pasture
- Pond
- Spring
- Trough
- Unidentified improvement

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:48,000 8,000

Feet

0 2

Kilometers

cted land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
s at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,00 scale.
otments, Pastures, and Range Improvements data supplied by BLM and USFS. BLM data updated 2012.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.5-1
Allotments and range improvements, MMPO area and selected land
Thompson Creek Mine EIS

3.4.3.6. Special Status Plant Species

No surveys for special status plant species were made for the Garden Creek property. However, suitable habitat (riparian) for the Idaho sedge occurs on the property and thus, Idaho sedge could occur on the property.

3.5. Range Resources

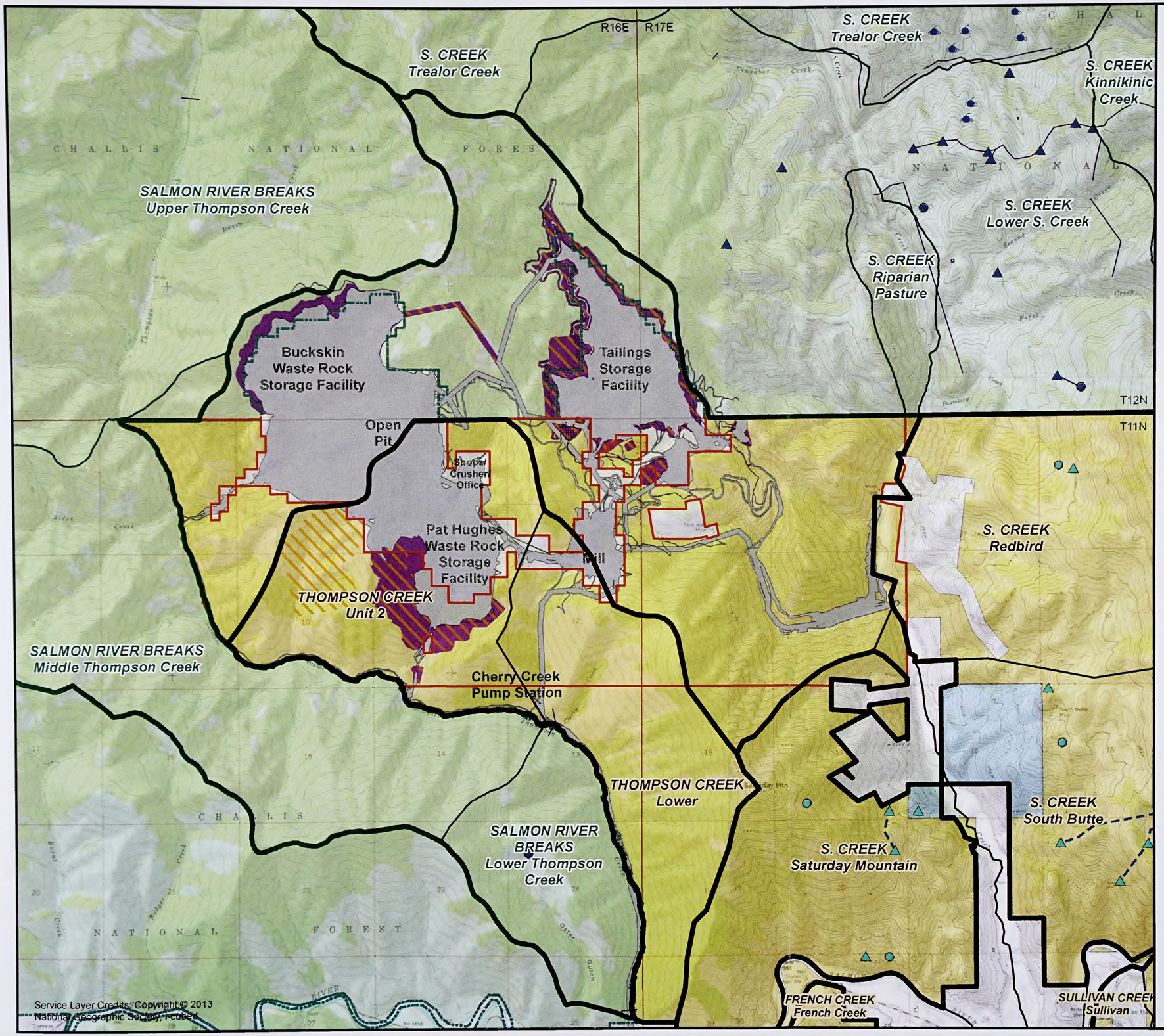
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North- and east-facing slopes are mostly forested, with Douglas-fir and sub-alpine fir (*Abies lasiocarpa*) interspersed with mountain meadows. Forested areas provide much less forage than the grassy mountain meadows. These meadows support similar species to those noted above with the addition of mountain brome (*Bromus montanus*). Slopes are also steep in this area. Forage production in an average year for these forest-meadow mosaic areas ranges from near 0 pounds per acre in thick forest to approximately 490 pounds per acre in meadows (NRCS 2007).



Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

BLM allotments, pastures, and range improvements

- BLM allotment
- BLM pasture
- Spring
- Trough
- Pipeline

Forest Service allotments, pastures, and range improvements

- Forest Service allotment
- Forest Service pasture
- Pond
- Spring
- Trough
- Unidentified improvement

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:48,000 8,000 Feet

0 2 Kilometers

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,00 scale.
Allotments, Pastures, and Range Improvements data supplied by BLM and USFS. BLM data updated 2012.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Service Layer Credits: Copyright © 2013 National Geographic Society, i-cubed

Figure 3.5-1
Allotments and range improvements, MMPO area and selected land
Thompson Creek Mine EIS

3.5.1.1. S. Creek Allotment

The S. Creek Allotment is 9,487 acres, of which 1,401 acres are privately owned, 440 acres are State land, and 7,646 acres are BLM land. Grazing vegetation species in the allotment include bluebunch wheatgrass and Idaho fescue. In 2002, when frequency studies were conducted, "there was none or very little range considered in poor condition" (BLM 2005b, p. 22).

The allotment has three pastures: Redbird, South Butte, and Saturday Mountain, all of which contain some of the MMPO area or selected land. These pastures are utilized in a deferred rest-rotation system (BLM 2002). There is a fence separating the South Butte and Redbird pastures from one another. Each pasture has at least one spring and several troughs and pipelines installed for livestock use (Figure 3.5-2). None of these springs or troughs are on the selected land. The allotment permittee is authorized to graze 142 cows from May 1 to July 4 and 160 cows from October 1 to October 30 for a maximum of 199 AUMs.

Livestock trailing occurs along S. Creek Road to access the allotment. BLM resource management objectives include not allowing livestock to linger along the road or the adjacent S. Creek. The riparian corridor along the creek is more than 100 feet wide in some locations and is dominated by pasture grasses, several willow species, cottonwood, red-osier dogwood (*Cornus sericea*), and Woods' rose. Several parcels along the S. Creek riparian corridor and adjacent wetland meadows are grazed during the authorized season of use. Except for one BLM parcel that is within private land, BLM land along S. Creek is unfenced; private parcels along S. Creek are fenced. Livestock are trailed to the uplands to alternative water sources in an effort to keep the cattle away from the creek. Cattle must trail through TCMC land to use the Saturday Mountain Pasture. Informal permission (no written agreement) from TCMC is currently granted on a case-by-case basis to the permittee for this trailing.

There is one designated monitoring area in a riparian area in the Redbird pasture along S. Creek, but cattle seldom use this riparian zone (BLM 2005b). Vegetation in the S. Creek Allotment is "adequate to provide for reproduction and recruitment...as well as provide adequate litter for decomposition to replenish soil nutrients and maintain ecological processes necessary for healthy plant communities" (BLM 2005b, p. 14). The current grazing management of the allotment is meeting the standards for rangeland health and is in conformance with the livestock grazing management guidelines in the *Idaho Standards for Rangeland Health and Guidelines for Livestock Grazing Management* published by the BLM in 1997 (BLM 1997, 2005b).

3.5.1.2. Thompson Creek Allotment

The Thompson Creek Allotment contains 3,329 acres of BLM land and 709 acres of private land. Grazing in the allotment was most recently managed in a two-pasture (Lower Pasture and Unit 2 Pasture) deferred rotation system for 23 days with 67 cows between July 1 and September 30 for a maximum of 51 AUMs. The season of use was greater than 23 days to provide flexibility in timing of grazing in the two pastures. Furthermore, a condition of the permit was that all livestock shall be moved into the upper unit (Unit 2 Pasture) after August 1 each year. This condition was included as specific mitigation to effects on fish species protected under the ESA. However, the grazing permit for the allotment was relinquished in January 2012, and the BLM could only re-issue the permit to provide short term flexibility to other permittees for vegetation treatments or other management actions affecting base permits (BLM 1999).

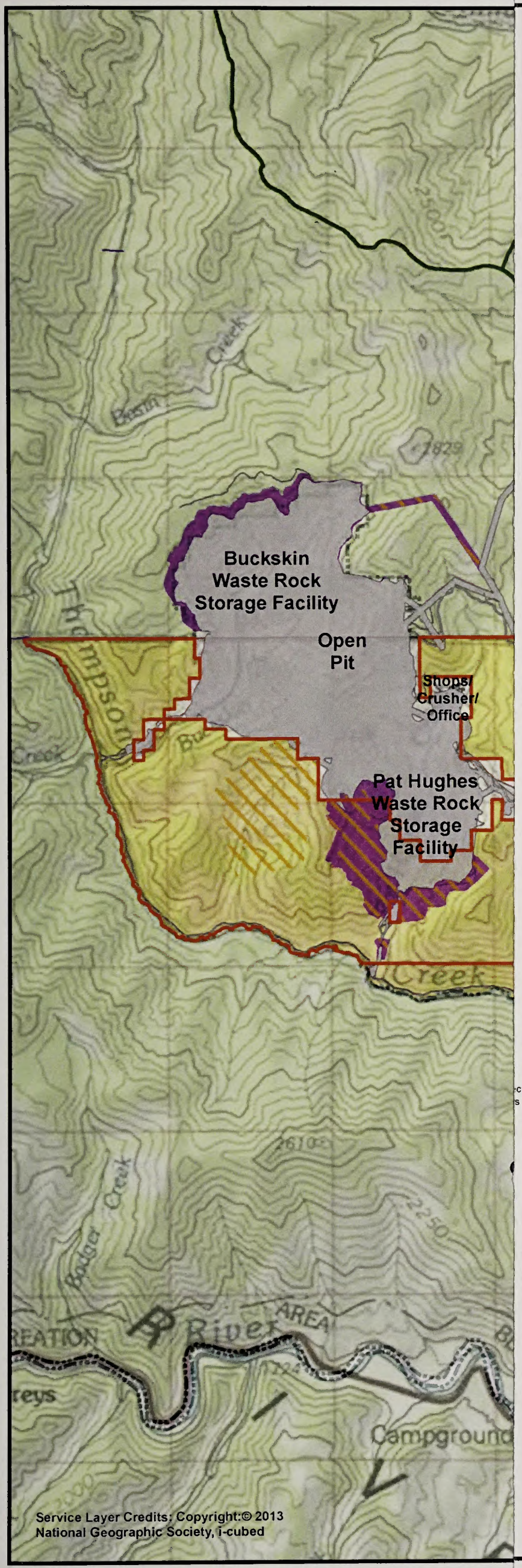
The physiographic setting of the allotment is steep canyon walls with dry Douglas-fir, and sagebrush-bluebunch plant associations on lower slopes and mixed stands of lodgepole pine and Douglas-fir on high slopes. Two-thirds of the allotment is on areas disturbed by mining or covered by steep limestone mountain mahogany communities, Douglas-fir communities, and subalpine fir communities. Only the remaining one-third of the allotment is suitable for grazing, which is covered by sagebrush/bunchgrass communities (key forage species are bluebunch wheatgrass and Idaho fescue) with a stocking rate of approximately 1 AUM per 20 acres. Cattle reach the allotment via the Thompson Creek Road, and distribute to upland sites to graze through the use of riders and salting practices. However, the topography and the availability of forage along Thompson Creek and the adjacent riparian/bench area are where most grazing occurs. The short duration of use (23 days) and grazing use criteria to trigger movement of livestock limit the current effect to the stream/aquatic habitat/fisheries resources. There are no developed springs or water features on the allotment, but water is available for grazing from Thompson Creek and other drainages.

3.5.2. Offered Lands – Broken Wing Ranch

The ranch contains irrigated areas and unimproved range land, as well as several buildings and houses. Most of the ranch is leased to a rancher who irrigates the fields to grow hay, and winter pastures his livestock on the ranch as a cow-calf operation (BLM 2010a). The ranch is no longer a base property for any BLM grazing permits. On average, each acre of irrigated hay land produces 2 tons of alfalfa/grass hay per acre. Yields could likely be improved if the fields were improved (replanted, re-leveled, etc.) (Baker 2011).

The rancher feeds 300 cows on the ranch and other nearby private land during mid-September through mid-May. Once surrounding rangeland is ready for grazing (usually in May), up to 236 cows move on to the adjacent BLM Bald Mountain Allotment to the west and/or BLM Split Hoof Allotment to the east until approximately June 16 each year (Figure 3.5-2). Most of the cows are then trailed onto the adjacent Forest Service S. Creek Allotment (different from the BLM S. Creek Allotment) until mid-August or October, depending on resource conditions. The cattle then pass back through the BLM allotments for up to 2 weeks, before moving back onto the Broken Wing Ranch. The base property for the BLM grazing permits for these allotments is private land (i.e., not the Broken Wing Ranch) owned by the rancher.

Subparcel BWR-1 straddles Lyon Creek and has 52 acres of sub-irrigated land. Typical forage species are wheatgrasses and fescues, and the meadow ("Graham Field") is composed of Nebraska sedge, Baltic rush, quackgrass, and Kentucky bluegrass. The meadow is flood irrigated between May and September (WSLM 2012) and will produce approximately 3 tons per acre of alfalfa hay, or will support 5 AUMs per acre if used for pasture (NRCS 2007). The meadow in BWR-1 historically has been grazed by 150 to 200 cow/calf pairs between the last week in April and mid-May. However, in 2012 TCMC installed 6,200 feet of riparian post and wire fence with jack post bracing around 42.9 acres of the subparcel to exclude cattle from the meadow, leaving 124.3 acres of unfenced rangeland in the subparcel. Under a conservation plan, the meadow will now be grazed either 1) during 3 to 5 days during the first week in May by 200 cow/calf pairs, or 2) during 3 to 5 days during mid- to late-October or the first week in November (cows only, no calves) (WSLM 2012).



Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

BLM Pastures and Range Improvements

- BLM S. Creek Allotment pasture
- Spring
- Trough
- Pipeline

Forest Service Pastures and Range Improvements

- Forest Service S. Creek Allotment pasture
- Pond
- Spring
- Trough
- Unidentified improvement

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:60,000 8,000

Feet

0 2

Kilometers

cted land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
s at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,00 scale.
Allotments, Pastures, and Range Improvements data supplied by BLM and USFS.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.5-2
Range improvements, S. Creek allotment
Thompson Creek Mine EIS

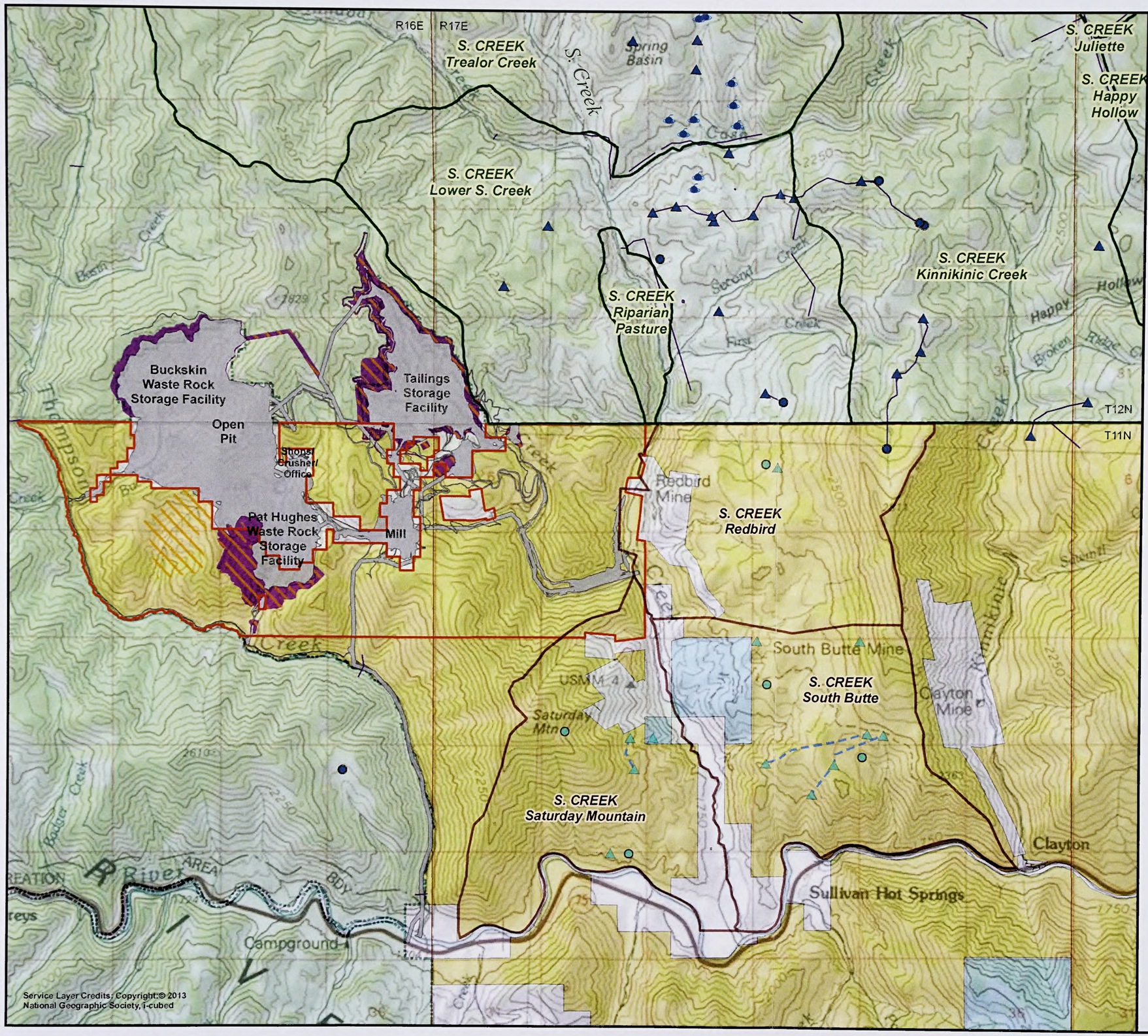
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Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

BLM Pastures and Range Improvements

- BLM S. Creek Allotment pasture
- Spring
- Trough
- Pipeline

Forest Service Pastures and Range Improvements

- Forest Service S. Creek Allotment pasture
- Pond
- Spring
- Trough
- Unidentified improvement

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:60,000 8,000 Feet

0 2 Kilometers

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,00 scale.
Allotments, Pastures, and Range Improvements data supplied by BLM and USFS.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.5-2
Range improvements, S. Creek allotment
Thompson Creek Mine EIS

R16E R17E

BWR South Rd

Poverty Flat Road

ciences.

Legend

- Broken Wing Ranch NEPA parcels
- BLM allotment
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- Trough

Fences

- Fair
- Good
- Poor

Irr

Figure 3.5-3
Fences and irrigation,
Broken Wing Ranch
Thompson Creek Mine EIS

R16E R17E T11N T10N

Split Hoof Allotment

Highway 75

BWR-1

BWR-2

BWR-3

BWR-4

BWR-5

BWR-6

BWR-7

Lyon Creek Road

Salmon River

Main BWR Road

Bald Mountain Allotment

Lehninger Spring Rd

Lyon Creek

Lower Sink Creek Rd

Sink Creek Road

Sink Creek

Poverty Flat Road

Legend

- Broken Wing Ranch NEPA parcels
- BLM allotment
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- Trough

Fences

- Fair
- Good
- Poor

Irrigation

- Flood
- Hand lines
- Pivot
- Wheel lines

NEPA parcels for the Broken Wing Ranch from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

0 1:24,000 4,000
Feet

0 1
Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.5-3
Fences and irrigation, Broken Wing Ranch
Thompson Creek Mine EIS

Approximately one-third of BWR-2 is flood-irrigated (~ 35 acres), one-third is irrigated with a pressurized circular irrigation system, and one-third is non-irrigated rangeland. Common grasses are wheatgrasses and fescues. When irrigated, these soils produce 3 to 4 tons per acre of alfalfa or grass hay, and can support approximately 8 AUMs per acre of forage if irrigated (NRCS 2007). In 2011 and 2012, TCMC installed 5,500 feet of riparian jack post and pole fence along the Salmon River, which combined with existing fencing excludes cattle on the north half of the ranch from most of the river (BWR-2, BWR-3, and portions of BWR-4) (WSLM 2012). Under the Lyon Creek conceptual restoration plan, the lower 1,850 feet of Lyon Creek would be fenced to exclude livestock and the four stream crossings would be consolidated.

Subparcel BWR-3 is almost all native rangeland straddling Lyon Creek. This land produces approximately 400 pounds per acre of dry forage in a typical year if not irrigated. If this subparcel were irrigated, the land would produce approximately 8 AUMs per acre of forage (NRCS 2007). TCMC installed a fish screen in 2012 on a diversion from Lyon Creek on BLM land (under an authorized ROW) approximately 500 feet northwest of the Lyon Creek ranch house. Instead of a leaky diversion ditch, the water is now piped to the irrigation equipment on BWR-2 and BWR-3. In addition, a pipeline was run from a spring near the diversion to a new watering trough on BWR-3 (with the ditch preserved as a cultural resource). The system is passive and designed to be frost free. Cattle now water from the trough instead of Lyon Creek and the Salmon River. Furthermore, the upper portion of the diversion ditch from BWR-1 has been abandoned (WSLM 2012).

Subparcel BWR-4 is in the ancestral floodplain of the Salmon River and includes three old oxbows that are sub-irrigated. Most of the parcel is flood-irrigated and is used for hay production, but native, non-irrigated pasture land is also present. This subparcel, when used as irrigated pasture, produces 5 to 8 AUMs per acre of forage (NRCS 2007). TCMC also installed a second off-stream cattle watering system on BWR-4 in 2012. Cattle now water from a trough supplied by a new well instead of watering in the Salmon River; the system is frost free. The company also installed jack pole and post fence around the historic Maraffio homestead to exclude cattle from the site (WSLM 2012).

Subparcel BWR-5 has both irrigated land (flood irrigation) and rangeland located on outwash plains. This subparcel produces 350 to 700 pounds per acre of forage as rangeland and 3 to 4 tons per acre of grass hay if irrigated. As irrigated pasture, the subparcel produces 5 to 8 AUMs per acre of forage (NRCS 2007).

Subparcel BWR-6 (120 acres irrigated) has two pressurized circular irrigation fields, one pipe-irrigated field, and non-irrigated rangeland (120 acres irrigated, 89 acres non-irrigated). If irrigated, the subparcel would support approximately 8 AUMs per acre (NRCS 2007).

Subparcel BWR-7 includes native sub-irrigated hay land and range land in the Salmon River floodplain next to an un-named, intermittent creek. When irrigated, the subparcel supports 7 AUMs per acre (NRCS 2007).

An irrigation ditch traverses BWR-4 whereas BWR-3, BWR-7, and portions of BWR-4 are naturally sub-irrigated (Baker 2010). Most of the pastures and fields at the ranch are fenced

(7.7 miles), with 42 percent of the fence in good condition, 23 percent in fair condition, and 35 percent in poor condition (Figure 3.5-3.).

3.5.3. Offered Lands – Garden Creek Property

The property is partially fenced with the BLM Old Tom Mountain Allotment adjacent to the east and NFS allotments 1156 and 1165 adjacent to the west and north. Therefore, grazing occurs on the property when the adjacent Federal allotments are grazed, and the property is managed integrally with the adjacent BLM and Forest Service allotments. Common range plants include mountain big sagebrush, Idaho fescue, bluebunch wheatgrass, alpine timothy (*Phleum alpinum*), and wood bluegrass (*Poa nemoralis*). Other shrub species include western snowberry antelope bitterbrush (*Purshia tridentata*) and Saskatoon serviceberry (*Amelanchier alnifolia*). Forage production on an average year ranges from approximately 675 pounds per acre to 700 pounds per acre (NRCS 1987) or 0.9 AUM per acre (72 AUMs) (1 AUM = 790 pounds of air dry forage, NRCS 2002b).

The Old Tom Mountain Allotment is currently used for fall sheep grazing. Generally, 1,200 sheep use the allotment during September and October, using approximately 473 AUMs (BLM 2010b). Sheep move freely between the BLM land, NFS land, and Garden Creek property. There are no fences between the BLM land and the property. There is a fence in good condition between the property and NFS land to the north, and a fence in poor condition between the property and NFS land to the east.

3.6. Water Resources

The analysis area for water resources for the MMPO alternatives and for the selected land component of the land disposal alternatives is the water in the potentially affected watersheds and channels:

- The Buckskin and Pat Hughes watersheds, the small watershed in between ("No Name"), the small unnamed watersheds east of the Pat Hughes watershed, the Cherry Creek watershed, and the underlying aquifers (underground layers of rock, sediment or soil that yield water);
- The Thompson Creek channel from the northern boundary of the selected land downstream to the confluence of Thompson Creek with the Salmon River;
- The Bruno Creek watershed, the Redbird Creek watershed (both tributaries to S. Creek), and the underlying aquifers;
- The S. Creek channel from the northern boundary of the selected land downstream to the confluence of S. Creek with the Salmon River; and
- The Salmon River between the mouths of Thompson and S. creeks.

The analysis area for the offered lands component of the land disposal alternatives is 1) the surface water related to the Broken Wing Ranch (Lyon Creek watershed, the ranch, and the portion of the Salmon River channel on the ranch); 2) the groundwater related to the ranch (the

ranch and adjacent lands with wells in the IDWR (2012) database); 3) the surface water related to the Garden Creek property (the property and the Garden Creek channel between 1,800 and 1,950 feet elevation); and 4) the groundwater related to the property (the property and adjacent lands with wells in the IDWR (2012) database).

3.6.1. MMPO Area and Selected Land

3.6.1.1. Surface Water

The MMPO area and the selected land are in the Thompson Creek (19,271 acres) and Lower S. Creek (12,159 acres) 6th level watersheds, with hydrologic unit codes (HUC) 170602010903 and 170602010803, respectively. These watersheds drain to the Salmon River basin (170602), which drains to the Lower Snake River subregion (1706). The existing and proposed mine disturbance is/would be in the Buckskin, Pat Hughes, Bruno, and No Name watersheds. Buckskin Creek, No Name Creek, and Pat Hughes Creek all drain to Thompson Creek. Bruno Creek drains to S. Creek, which drains into the upper Salmon River 4 miles downstream of the confluence of Thompson Creek with the Salmon River (Figure 3.6-1). Redbird Creek, a tributary to S. Creek, is northeast of the Bruno Creek watershed.

Stream Characteristics

Thompson Creek

Thompson Creek drains 29.1 square miles and is a second order stream 12.2 miles in length from its headwaters near the mine to the confluence of Thompson Creek with the Salmon River. Thompson Creek is in a narrow canyon with steep, moderately dissected side slopes. This topography constrains the active channel and limits floodplain development. In addition, the public and private sections of Thompson Creek Road constrain the active channel in some locations along Thompson Creek. The average stream gradient is 2.5 percent and average width is approximately 13 feet (GEI 2011). The larger tributaries (by flow) to Thompson Creek include Basin Creek (north of the analysis area), Buckskin Creek, Alder Creek (west of the analysis area), and Pat Hughes Creek (IDFG 2005a). Portions of Thompson Creek upstream of the mouth of Buckskin Creek are more heavily shaded by Douglas-fir than downstream of the mouth where Thompson Creek tends to be more dominated by cottonwood (VTN 1980c).

Buckskin Creek

Buckskin Creek drains 2.5 square miles and is a first order tributary to Thompson Creek. Buckskin Creek has been distinctly affected by the mine, with a large cross-valley-fill WRSF in much of the drainage. As a result, less than ¾ mile of Buckskin Creek remains unburied. Furthermore, the section of stream that remains is not a free-flowing stream, but functions as part of the mine water management system. That is, the only water in the stream is that collected from the toe of the Buckskin WRSF or small amounts of groundwater intercepted due to natural gain. The collected water is either released along a small channel that has been distinctly modified over the years to Thompson Creek via a NPDES discharge point (Outfall 001) at the base of a sedimentation pond, or transmitted via the Thompson Creek pipeline to the Cherry Creek pump station (discussed further under Streamflow Characteristics below).

Pat Hughes Creek

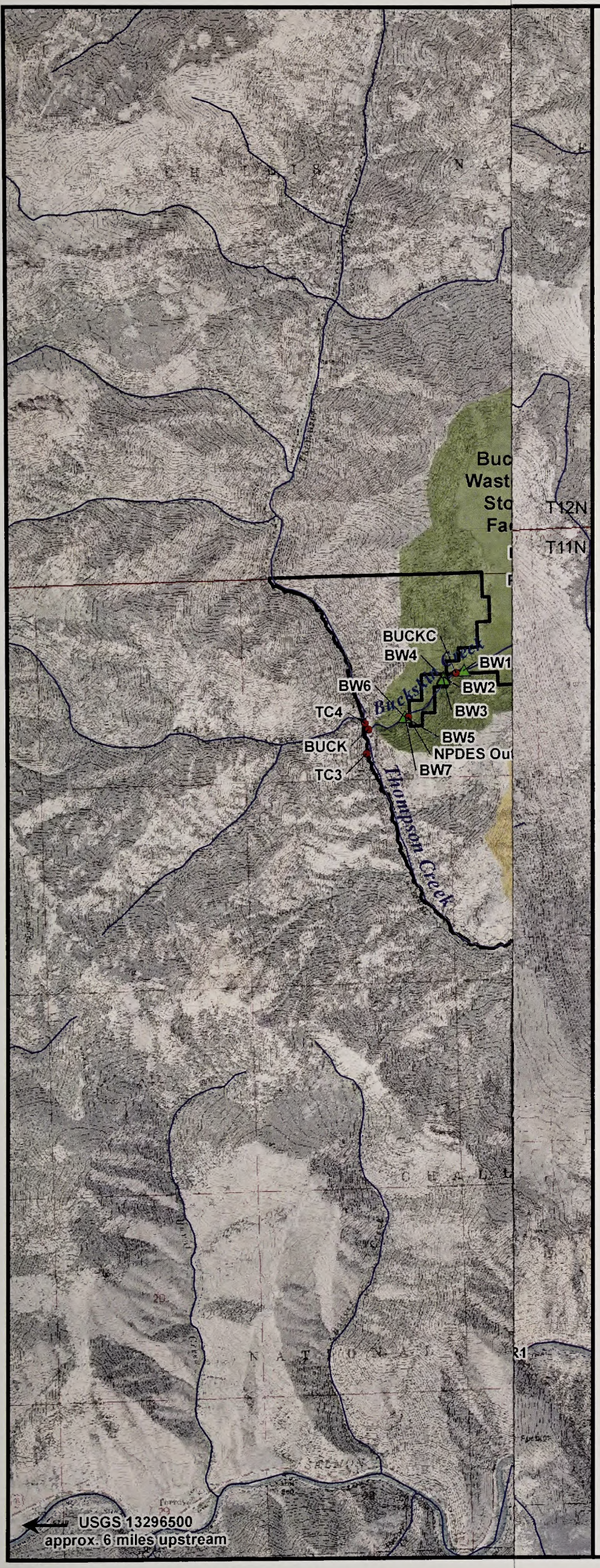
Pat Hughes Creek drains 2.4 square miles and is a first order tributary to Thompson Creek that has also been distinctly affected by a large cross-valley-fill WRSF in much of the drainage. Similar to Buckskin Creek, the portion of Pat Hughes Creek that remains (< ¾ mile) is not a free-flowing stream, but part of the mine water management system. Water from the toe of the Pat Hughes WRSF, the Pat Hughes diversion pipeline, or intercepted groundwater is either released through a NPDES discharge point (Outfall 002) to Thompson Creek, or transmitted by the Thompson Creek pipeline to the Cherry Creek pump station (Figure 2.1-2). Pat Hughes Creek does not provide fish habitat (discussed further under Streamflow Characteristics below).

S. Creek

S. Creek drains 79.2 square miles and is a second order stream 15.5 miles in length from its headwaters north and east of the mine to the confluence of S. Creek with the Salmon River. S. Creek is in a narrow valley with steep, moderately dissected side slopes along much of its length. As a result, floodplain development is also limited along much of its length. Furthermore, S. Creek Road is next to approximately 12 miles of S. Creek from the trailhead at the confluence of Martin Creek with S. Creek to the confluence of S. Creek with the Salmon River, and the road constrains the active channel of S. Creek in some places. However, approximately 1 mile above the confluence of Bruno Creek with S. Creek, the terrain begins to open into a broader valley bottom, with better developed floodplains (IDFG 2004). The average gradient of S. Creek (1.3 %) is lower than that of Thompson Creek (2.5 %), and the average width of S. Creek (~ 20 feet) is wider than that of Thompson Creek (13 feet) (GEI 2011). S. Creek is fed by more than a dozen smaller tributaries on NFS land upstream of the confluence of Bruno Creek with S. Creek; Bruno Creek is the principle S. Creek tributary on the selected land. Portions of S. Creek upstream of the mouth of Bruno Creek have moderate canopy cover of willow, cottonwood, and aspen. Below the mouth of Bruno Creek, riparian vegetation is more open, with some large patches of cottonwood (VTN 1980c).

Bruno Creek

Bruno Creek drains 6.3 square miles and is a second order tributary to S. Creek. Bruno Creek is approximately 6 miles in length from its headwaters near the mine to the confluence of Bruno Creek with S. Creek. Typical of other tributaries in the analysis area, Bruno Creek has a relatively steep gradient within a narrow canyon that limits floodplain development. The construction of the TSF in 2 miles of the Bruno Creek drainage has divided Bruno Creek into two separate reaches. Upstream of the TSF, the headwaters of Bruno Creek have not been directly affected by mine activity (i.e., filled by tailings or dewatered by flow diversions). However, the headwaters are fragmented from downstream portions of the creek by the TSF. Also as a result of the TSF and flow diversion, downstream reaches have been distinctly affected by mine activity, primarily through the loss of streamflow (discussed further under Streamflow Characteristics below).



Legend

- Selected land
- Surface water monitoring site
- Monitoring well
- Bruno Creek drainage basin
- Buckskin Creek drainage basin
- No Name Creek drainage basin
- Open Pit drainage basin
- Pat Hughes Creek drainage basin
- Redbird Creek drainage basin

N

1:48,000

0 4,000

Feet

0 1

Kilometers

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-1
Analysis area watersheds and monitoring sites
Thompson Creek Mine EIS

Pat Hughes Creek

Pat Hughes Creek drains 2.4 square miles and is a first order tributary to Thompson Creek that has also been distinctly affected by a large cross-valley-fill WRSF in much of the drainage. Similar to Buckskin Creek, the portion of Pat Hughes Creek that remains (< ¾ mile) is not a free-flowing stream, but part of the mine water management system. Water from the toe of the Pat Hughes WRSF, the Pat Hughes diversion pipeline, or intercepted groundwater is either released through a NPDES discharge point (Outfall 002) to Thompson Creek, or transmitted by the Thompson Creek pipeline to the Cherry Creek pump station (Figure 2.1-2). Pat Hughes Creek does not provide fish habitat (discussed further under Streamflow Characteristics below).

S. Creek

S. Creek drains 79.2 square miles and is a second order stream 15.5 miles in length from its headwaters north and east of the mine to the confluence of S. Creek with the Salmon River. S. Creek is in a narrow valley with steep, moderately dissected side slopes along much of its length. As a result, floodplain development is also limited along much of its length. Furthermore, S. Creek Road is next to approximately 12 miles of S. Creek from the trailhead at the confluence of Martin Creek with S. Creek to the confluence of S. Creek with the Salmon River, and the road constrains the active channel of S. Creek in some places. However, approximately 1 mile above the confluence of Bruno Creek with S. Creek, the terrain begins to open into a broader valley bottom, with better developed floodplains (IDFG 2004). The average gradient of S. Creek (1.3 %) is lower than that of Thompson Creek (2.5 %), and the average width of S. Creek (~ 20 feet) is wider than that of Thompson Creek (13 feet) (GEI 2011). S. Creek is fed by more than a dozen smaller tributaries on NFS land upstream of the confluence of Bruno Creek with S. Creek; Bruno Creek is the principle S. Creek tributary on the selected land. Portions of S. Creek upstream of the mouth of Bruno Creek have moderate canopy cover of willow, cottonwood, and aspen. Below the mouth of Bruno Creek, riparian vegetation is more open, with some large patches of cottonwood (VTN 1980c).

Bruno Creek

Bruno Creek drains 6.3 square miles and is a second order tributary to S. Creek. Bruno Creek is approximately 6 miles in length from its headwaters near the mine to the confluence of Bruno Creek with S. Creek. Typical of other tributaries in the analysis area, Bruno Creek has a relatively steep gradient within a narrow canyon that limits floodplain development. The construction of the TSF in 2 miles of the Bruno Creek drainage has divided Bruno Creek into two separate reaches. Upstream of the TSF, the headwaters of Bruno Creek have not been directly affected by mine activity (i.e., filled by tailings or dewatered by flow diversions). However, the headwaters are fragmented from downstream portions of the creek by the TSF. Also as a result of the TSF and flow diversion, downstream reaches have been distinctly affected by mine activity, primarily through the loss of streamflow (discussed further under Streamflow Characteristics below).

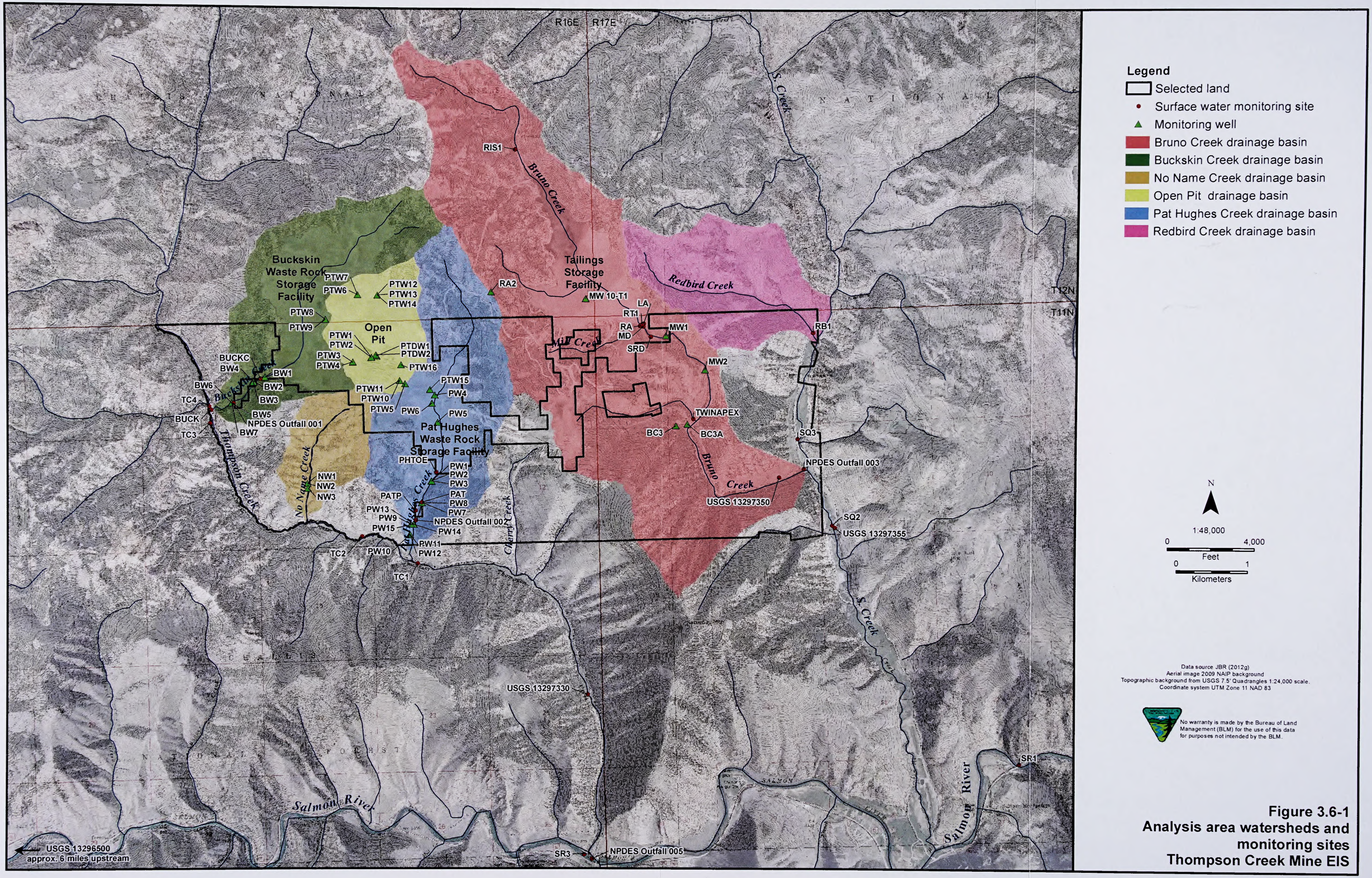


Figure 3.6-1
Analysis area watersheds and monitoring sites
Thompson Creek Mine EIS

Salmon River

The Salmon River is a seventh order stream that is a major tributary to the Snake River. However, unlike the Snake River, there are no dams on the Salmon River. The Salmon River upstream of the analysis area drains an area of approximately 800 square miles (512,000 acres). The Salmon River is approximately 80 feet wide in the analysis area with very little shading from riparian vegetation or topography (GEI 2011). Riparian vegetation is limited to a narrow strip of dogwood, willow, alder, and sparse cottonwood bounded by steep talus slopes, US Highway 93, and developed private land. As a result, water temperatures are elevated during summer months. Multiple irrigation diversions exacerbate this condition by reducing flows relative to historic levels. Flows in the Salmon River (as measured ~ 11 miles upstream of the analysis area) vary seasonally typical of snowmelt driven systems.

Streamflow Characteristics

The Salmon River, Thompson Creek, and S. Creek are perennial mountain streams whose flows vary greatly both seasonally and annually (USGS 2012c, stream gage data) (Figure 3.6-1). In general, flows in these channels and their tributaries are dominated by seasonal snowmelt run-off. Consequently, the highest flows occur in the late spring and early summer with peak flows typically occurring in June for the Salmon River as the winter snowpack melts in addition to spring rainfall. Flows then decrease in these streams until a regular base flow is established during the fall and winter months.

USGS Station No. 13296500 (Salmon River below Yankee Fork) is approximately 11 miles upstream of the mouth of Thompson Creek. Average monthly flows at this point on the Salmon River vary seasonally by an order of magnitude, with the winter months averaging approximately 400 cfs and the June flow average approaching 3,000 cfs (USGS 2012c).

The USGS (in cooperation with the IDWR) began gaging Thompson Creek near Clayton (USGS Station No. 13297330) in 1972. The gaging station is 1.2 miles upstream of the mouth of Thompson Creek, and downstream of the current open pit, WRSFs, and permitted NPDES Outfall 001 and Outfall 002. As with the Salmon River, Thompson Creek is at its highest in the spring, with flows dropping in late summer into fall (Figure 3.6-2). Thompson Creek generally contributes less than 1 percent of the flow in the Salmon River.

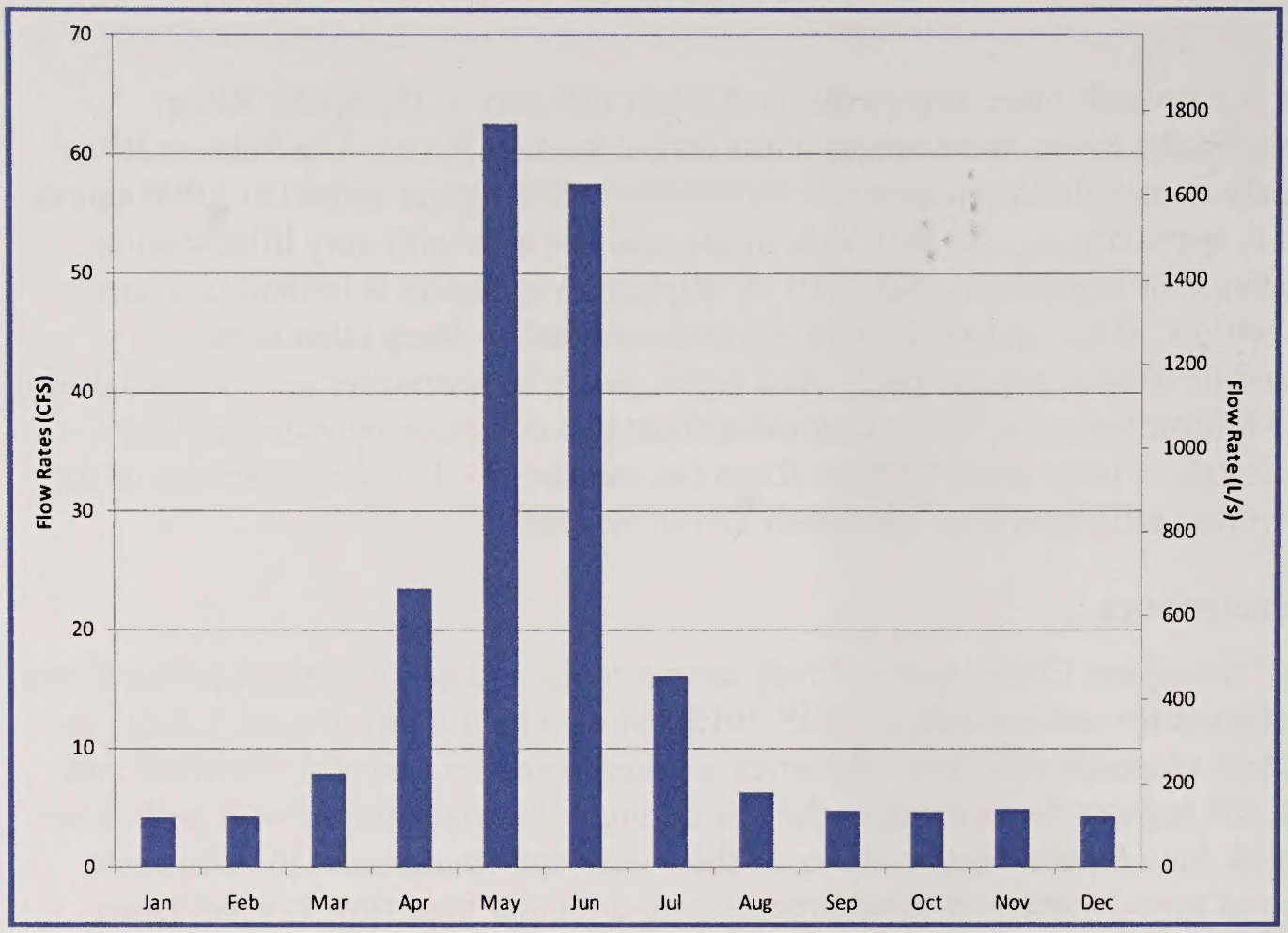


Figure 3.6-2. Distribution of mean monthly flow rates, Thompson Creek.

The USGS-IDWR cooperative stream gaging station on S. Creek (USGS Station No. 13297355) also began operating in 1972. The gaging station is approximately 3 miles upstream from the mouth of S. Creek, and is downstream of the TSF and NPDES Outfalls 003 and 004. With a similar flow distribution as Thompson Creek, the average monthly flows of S. Creek are approximately twice those of Thompson Creek (Figure 3.6-3.) (USGS 2012c).

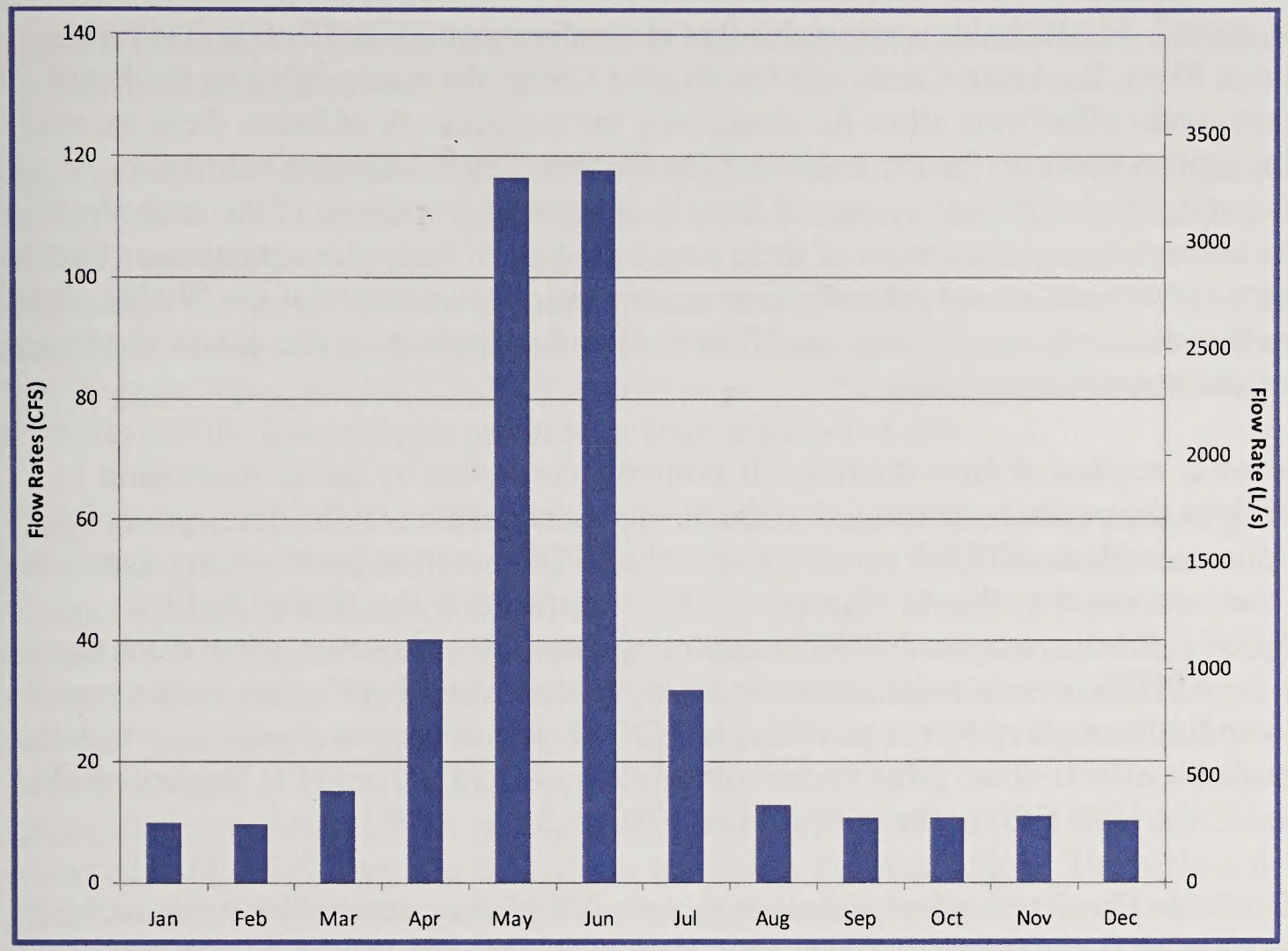


Figure 3.6-3. Distribution of mean monthly flow rates, S. Creek.

As part of the process to determine effluent limitations for NPDES discharges, the EPA derives flow characteristics for receiving streams. Among these characteristics is the 7 day/10 year low flow (lowest 7 day flow that can be expected to occur on average once every 10 years) (7Q10 flow), which is used as a basis for protection of aquatic life from chronic effects. Therefore, the 7Q10 flow represents a much lower flow than average base flow, which is a more regular seasonal low-flow condition. The current effect of the mine is already reflected in the current 7Q10 flow for the Salmon River, Thompson Creek, and S. Creek (Table 3.6-1).

Table 3.6-1. Estimated 7Q10 flows.

Stream	7Q10 Estimate (cfs)
Salmon River	103
Thompson Creek	2
S. Creek	5

As discussed below, some of the streamflow characteristics of smaller watersheds to Thompson and S. creeks have been altered by the mine. In addition, the streamflow characteristics of Buckskin and Pat Hughes creeks upstream of their confluences with Thompson Creek have been

altered by the mine.[8] TCMC holds water rights that allow diversion of 20.86 cfs collectively from the Salmon River, Buckskin Creek, and Pat Hughes Creek; the water rights on Buckskin and Pat Hughes creeks effectively allow for dewatering these creeks. In addition, there are one or more sedimentation ponds in the Buckskin and Pat Hughes Creek drainages below the WRSFs. The ponds are designed to collect all flow in the upstream portions of the watersheds. Therefore, the stream channels upstream of these ponds are part of the water management system for mine-affected water and are not naturally flowing streams. Downstream of the WRSFs, these stream channels convey only stormwater run-off from disturbed surfaces at the mine and seepage collected from the base of the WRSFs.

Flow into the lower reaches of these drainages is primarily controlled by the sedimentation ponds. Water from the ponds is discharged to the downstream portions of the drainages only when in compliance with the NPDES permit. Under the NPDES permit, the receiving stream is Thompson Creek and water quality in Thompson Creek must meet Idaho Water Quality Standards (WQS) at the downstream NPDES monitoring locations. However, when discharge occurs under the NPDES permit, water quality in lower Buckskin and Pat Hughes creeks would meet the effluent limits required by the permit. The NPDES permit ensures compliance with the WQS. The probable effects of the mine on the natural flow of Buckskin and Pat Hughes creeks were described in the 1980 EIS for the mine (USFS 1980, p. 5-7).

Most of the Buckskin Creek watershed and channel are a WRSF (i.e., covered by waste rock) or are part of the open pit (i.e., was excavated as part of pit development). The Buckskin Creek flows are thus affected by the mine facilities that intercept run-off, retain run-off, and/or release flows at a regulated rate. Lower Buckskin Creek flows are dominated by regulated discharges from the Buckskin Creek sedimentation pond. In addition to run-off from the mine and from the adjacent undisturbed portions of the watershed, the pond also collects WRSF seepage. Discharge from the pond (via Outfall 001) occurs only when flows in Thompson Creek (measured at a USGS gaging station) are greater than 7 cfs. When not discharged from the outfall, the flows are either retained in the pond or pumped to the mill for reuse. This water is conveyed by the Thompson Creek pipeline and the Cherry Creek pumping station where flows are pumped back to the existing PWTP at the mill and the treated water is used in the mill process. Groundwater and seepage from the Buckskin WRSF contribute flow to Thompson Creek via Buckskin Creek (Section 3.6.1.2.).

Currently, much of the Pat Hughes watershed and channel are occupied by the WRSF and the open pit. Unlike the flow in Buckskin Creek, some of the Pat Hughes flow is intercepted above the mine and routed around the Pat Hughes WRSF to the Pat Hughes sedimentation pond. In addition, the pond also collects run-off from the mine shop and vehicle hot start area. Seepage from the Pat Hughes WRSF formerly discharged to the pond. However, in 1999 TCMC stopped allowing this seepage into the pond, and instead began collecting and piping the seepage to the mill via the Thompson Creek pipeline and the Cherry Creek pumping station. As with the Buckskin Creek sedimentation pond, discharges from the Pat Hughes pond occur only when effluent limits at NPDES Outfall 002 can be met. The Pat Hughes watershed also contributes

[8] The probable effects of the mine on the natural flow of Buckskin and Pat Hughes Creeks was described in the 1980 EIS for the mine development (USFS 1980, p. 5-7).

regional (unaffected) groundwater as well as potentially seepage-affected local groundwater to Thompson Creek (Section 3.6.1.2).

Another small watershed with altered hydrology is Bruno Creek, a perennial stream that is a tributary to lower S. Creek (Figure 3.6-1). The TSF captures run-off from a substantial portion of the Bruno Creek watershed. The headwaters of Bruno Creek can either flow into the TSF and become part of the mine makeup water system, or be diverted around the TSF in a pipeline and re-released to the stream downstream of the TSF. This upstream water source reflects a natural flow regime. Over the 1987 to 2009 period of record, the highest streamflow occurred in June (~ 2 cfs) and the lowest flows occurred in December (~ 0.4 cfs).

Flows in the middle and lower reaches of Bruno Creek are influenced by natural geologic conditions and hydrologic alterations due to the mine (e.g., water management, sediment ponds, tailings water, TSF seepage, run-off, etc.). The Twin Apex abandoned mine (on private land not owned by TCMC) contributes flow to lower Bruno Creek. This portion of Bruno Creek has perennial flow due to the portal discharge, flow from the alluvium and colluvium, and springs issuing from bedrock fractures. The average annual flow in Lower Bruno Creek during the period of record (1971 to 2010) is approximately 1 cfs (UGSG 2012c). According to these same gaging station records (USGS gaging station No. 13297350), the peak flow of record is 42 cfs, recorded in May 1972 prior to the tailings embankment construction. The highest peak flow since the early 1980s was approximately half that amount, when 22 cfs was recorded in June 1986. The lowest daily flows typically occur in the winter months and are only about ¼ cfs (USGS 2012c).

Redbird Creek flows into S. Creek just upstream of the confluence of Bruno Creek with S. Creek (Figure 3.6-1). The Redbird Creek watershed does not have surface disturbance from the mine, but flows in Redbird Creek are inferred to be affected by the TSF (Section 3.6.1.2). While Redbird Creek streamflows are not often measured, two flow measurements were made at the mouth of the stream: approximately 0.33 cfs and 0.40 cfs in October 2010 and January 2011, respectively.

Other small watersheds, tributary to either Thompson or S. creeks, are on the selected land e.g. a portion of the Cherry Creek watershed. Flows (ephemeral or intermittent) are not monitored in the Cherry Creek drainage, and there is minor, mine disturbance in this watershed. In addition, No Name Creek (perennial flow) drains a small area between Buckskin and Pat Hughes creeks (Figure 3.6-1). A few small, but unnamed, watersheds on the selected land do not have perennial flow and do not have any appreciable mine disturbance.

Flood events chosen for structure sizing in this area typically come from intense rainfall, rather than snowmelt run-off. During the years in which TCMC was designing and operating the mine, flood flows have been estimated by various methods and entities for the smaller watersheds with planned or implemented mine disturbance. The estimates have varied accordingly, but the current and future precipitation depths that serve as design storms for the mine are 3.46 inches for the 100 year/24 hour storm and 4.05 inches for the 500 year/24 hour storm. Both values are based on the National Ocean and Atmospheric Administration (NOAA) Hydrometeorological Design Studies Center information (NOAA 2013a). The design storms are applicable to the

majority of the water management facilities (Section 4.6). The frequency of the design storms (i.e., 100 years, 500 years) and duration (24 hours) is based on BLM, Forest Service, and/or IDL requirements. However, where the consequence of failure is exceedingly high and structures are intended to function perpetually (i.e., the TSF), a recurrence interval approach is not typically used. Instead a probable maximum precipitation depth is used to calculate a probable maximum flood event. The probable maximum precipitation depth at the mine is 15.32 inches for a 24 hour storm using NOAA information and methods.

Regardless of methods, recurrence interval estimates are probability-based. For example, just because a 100 year event is expected, on average, to occur once every 100 years, it does not mean that it will not occur more – or less – often in any given time period. This is also true for flows on the opposite end of the spectrum, such as the 7Q10 flow. Furthermore, inherent to these methods is the expectation that past conditions are indicative of the future conditions, so the issue of climate change adds uncertainty. For example, the NOAA has not yet identified any statistically significant trends in the annual maximum series of observations used in its precipitation frequency analysis, and the effect of potential changes in climate on precipitation frequency estimates is uncertain (NOAA 2013b). Other parameters related to surface water resources that similarly would be affected by climate change include changes in evaporation and/or evapotranspiration, changes in precipitation variability, changes in timing and type (rain versus snow) of precipitation, and increased occurrence of extreme weather events. However, as for precipitation frequency, the results of computer simulations from climate models for these parameters are still far too uncertain for site-specific analysis in small watersheds, particularly in mountainous terrain (JBR 2014j, Section 4.10.3.4).

These aspects of climate change are not quantifiable either singularly or in combination, but these aspects have the potential to affect surface water resources by increasing the level of uncertainty associated with hydrologic and water quality predictions. Low-frequency events could happen more often, or, alternatively, quantities associated with a low-frequency flood increase, or quantities associated with a low-frequency low flow such as the 7Q10 could become even lower.

Surface Water Quality

Acid Rock Drainage

ARD, also commonly referred to as *acid mine drainage*, is the outflow of acidic water with elevated concentrations of metals derived from geologic materials, commonly waste rock or tailings from metal and coal mines. The acidity causes relatively high concentrations of metals to dissolve in the water.[9] The acidity may be neutralized within a few hundred feet of the acidic water entering streams due to dilution and reactions with the atmosphere and substrate, but the metals commonly remain dissolved for many miles downstream. That is, the primary effect of ARD is elevated concentrations of metals.

[9] Acidity is the concentration of hydrogen ions (charged atoms) in water. The hydrogen ions preferentially displace metal ions at the surfaces of rock particles. Alkalinity is the capacity of water to neutralize acidity (consume hydrogen ions). A common neutralizing substance is bicarbonate (HCO_3^-) typically derived from the dissolution of carbonate minerals such as ($CaCO_3$).

ARD occurs when sulfide minerals are exposed to air (oxygen) and water, and there is insufficient capacity (alkalinity) in the water to neutralize the acidity (i.e., hydrogen ions) generated by the oxidation of the sulfide minerals. In undisturbed natural systems the oxidation process occurs at slow rates over geologic time periods. However, when large amounts of rock are fractured (e.g., removed from an open pit and placed in WRSFs, or further crushed in a mill and placed in a TSF), the surface area of the waste material is much greater than when *in-situ*, and thus a greater amount of sulfide minerals are prone to exposure to oxygen and water. If the material contains a sufficient amount of sulfide (acid-generating) minerals and an insufficient amount of carbonate (acid-neutralizing) minerals, water in contact with the material will become acidic. If relatively large amounts of metal ions are available in the material, the concentrations of metals in the water will distinctly increase, particularly for the more soluble metals such as copper and zinc as opposed to lead.

Surface Water in the Analysis Area

Water quality varies throughout the analysis area due to geology, mine influences, and other considerations, but there are several commonalities. First, because streamflows are distinctly influenced by snowmelt run-off, certain aspects of their quality vary with flow rate and season. During the spring snowmelt run-off, the base flow is diluted resulting in lower conductivity, hardness, concentrations of dissolved solids, and concentrations of various dissolved trace metals (i.e., metals naturally present in very small concentrations).

The Buckskin and Pat Hughes stream channels are used as conveyances for run-off from the mine and seepage from the WRSFs. Therefore, these streams have become part of the mine water management system and their surface water chemistry has been altered. Note that for Buckskin and Pat Hughes creeks, the water quality described below is not always typical of the water released from these watersheds to Thompson Creek because much of the Buckskin and Pat Hughes flows are collected and used in the mill. The same situation applies to the description of the water quality in upper Bruno Creek (containing the TSF). This water is not released to lower Bruno Creek/S. Creek. In addition, the water quality of lower Bruno Creek is also affected by the addition of metals from Twin Apex Creek, which is not affected by the mine.

The IDEQ has developed WQSs for surface water based on its defined beneficial uses (IDAPA 58.01.02). Most streams, including those in the analysis area, are designated for beneficial uses of cold water aquatic life, salmonid spawning, and primary or secondary contact recreation. In addition, the Salmon River in the analysis area is designated as a domestic water supply. The defined beneficial uses are part of the WQSs, which also prescribe certain criteria that must be met to ensure the beneficial uses of the water are supported. The criteria may be numeric (parameter-specific) or narrative. Numeric criteria are use-specific, whereas narrative criteria are general applying to all surface water regardless of use. Narrative criteria are statements that describe the desired water quality goal, e.g., free from toxic substances in concentrations that impair beneficial uses.

The WQSs for aquatic life are divided into acute or criteria maximum concentration (CMC) standards and chronic or criterion continuous concentration (CCC) standards. The standards are protective of the environment and include safety factors, i.e., exceeding a standard does not mean that an adverse effect would occur, only that an adverse effect could occur. The standards are

protective of the environment if not exceeded more than once every 3 years. The CMC standard is for the 1 hour average concentration and the CCC standard is for the 4 day average concentration. Therefore, only constituents for which a concentration could exceed a WQS are discussed in detail in the FEIS.

Seven of these WQSs apply to elements that are known to be elevated in water that has contacted earth materials at the mine (Table 3.6-2). These are discussed in detail in the FEIS. Other constituents are also known to be elevated in the various mine waters, but are not subject to WQS for aquatic life. These are also discussed in the FEIS. The standard chemical symbols are used for the names of chemicals in all of the tables in the FEIS.

Table 3.6-2. Water quality standards.
all concentrations in micrograms per liter (µ/L)

Chemical	Aquatic Life[c]					
	CMC	CCC	CMC	CCC	CMC	CCC
	Thompson Creek with hardness of 47 mg/L[d]		S. Creek with hardness of 157 mg/L		Salmon River with hardness of 62 mg/L	
As	340	150	340	150	340	150
Cd[a]	0.71	0.37	1.96	0.74	0.9	0.43
Cu[a]	8.4	6	26	16.7	10.8	7.5
Pb[a]	28	1.1	105	4.1	38	1.5
Ni[a]	247	27	686	76	312	35
Se[b]	20	5	20	5	20	5
Zn[a]	62	62	172	173	78	79

[a] The criteria for these metals are hardness dependent. The hardness is the median hardness for the 10 year data set from only measurements during low flow measurements.

[b] The selenium criteria apply to the concentration of total (unfiltered) selenium. The criteria for all other chemicals apply to the concentration of the dissolved (filtered) chemicals.

[c] In 1993, EPA determined that metals criteria for aquatic life are most appropriately based upon dissolved (filtered) concentrations because "dissolved metal more closely approximates the bioavailable fraction of metal in the water column than does total recoverable metal" (EPA 1993). However, the selenium (not really a metal) aquatic life criteria is more appropriately based upon total (filtered; specifically, total recoverable) because of variations in how it speciates and how aquatic life uptakes it (EPA 1987).

[d] mg/L = milligrams per liter

The IDEQ documents the status of the quality of the waters in Idaho in an integrated report (IR) released every other year under the requirements of Section 303(d) and Section 305(b) of the CWA. The most recent IR is for 2010 (IDEQ 2011a); the 2012 IR has not yet been released. The IR lists the current conditions of all waters, and those waters that are impaired and need a total maximum daily load (TMDL). The latter waters are commonly referred to as 303(d)-listed. In listing the current conditions of the waters, the IR assesses whether or not waters support their defined beneficial uses. Streams are categorized as *fully supporting* all of their assigned

beneficial uses; *not supporting* all or some of their beneficial uses; or *not assessed* during the 2 year cycle for some or all of their beneficial uses. Streams with a support status of *not supporting* make up the Section 303(d) list of *impaired* waters. Some beneficial uses for some streams are not assessed in every 2 year cycle, most commonly when no applicable data is available to determine support status.

The IR provides the following information for the receiving streams in the analysis area. Thompson Creek (source to mouth) is fully supporting its beneficial uses. No Name Creek was not specifically assessed, but was considered as within the Thompson Creek unit, and thus is fully supporting. The status of Buckskin and Pat Hughes creeks is somewhat more complicated and is discussed below in more detail. Bruno Creek (source to mouth) does not support its cold water aquatic life or salmonid spawning beneficial uses due to combined biota/habitat bioassessments, but fully supports its secondary contact recreation beneficial use. S. Creek (downstream of Cash Creek) fully supports its aquatic life beneficial uses; salmonid spawning and secondary contact recreation beneficial uses were not assessed. Redbird Creek was not specifically assessed, but was considered as within the S. Creek unit, and thus is fully supporting. Upstream of Thompson Creek, the Salmon River fully supports all of its beneficial uses (i.e., cold water aquatic life, primary contact recreation, salmonid spawning, and domestic water supply). Between the mouths of S. and Thompson creeks, the Salmon River is 303(d)-listed for not supporting its cold water aquatic life beneficial uses due to sedimentation/siltation and water temperature. Domestic water supply, primary contact recreation, and salmonid spawning beneficial uses were not assessed for the Salmon River. The Salmon River downstream of S. Creek fully supports the cold water aquatic life and primary contact recreation beneficial uses; support for salmonid spawning uses was not assessed (IDEQ 2011a).

The water in Buckskin Creek is well buffered. Throughout the analysis period, the water has been alkaline (~ pH 8.0) with a typical total alkalinity (as calcium carbonate, $CaCO_3$) of approximately 145 mg/L. The hardness (the concentration of dissolved calcium and magnesium) has been steadily increasing since 1999, and is now approximately 800 mg/L. The increase is due to increasing concentrations of calcium in seepage water from the Buckskin WRSF. The concentrations of sulfate (SO_4^{2-}) in the seepage water have also increased from approximately 600 mg/L in early 2000 to approximately 1,050 mg/L in late 2010.

Buckskin Creek upstream of the sedimentation pond in the drainage has been used to convey all run-off and seepage collected from the Buckskin WRSF since the beginning of mine construction in 1981. Water from the pond can be discharged to lower Buckskin Creek per the NPDES discharge permit or routed to the Thompson Creek pipeline. Seepage from the unlined pond has historically escaped downstream of the pond in the drainage, where the seepage could affect the water quality in lower Buckskin Creek. A pipeline was installed in 2011 that conveys seepage water collected from the Buckskin WRSF directly to the Thompson Creek pipeline. This has improved the water quality in the pond and in Buckskin Creek downstream of the pond. Lower Buckskin Creek downstream of the pond will continue to be the conveyance for water discharged from the pond downstream to the confluence of Buckskin Creek with Thompson Creek, the receiving stream for this outfall (Outfall 001).

Table 3.6-3. Buckskin Creek water quality, monitoring site Buck.

Parameter	Units	Sample count	Median	Mean	95th %	Count < detect.
pH	Standard Units (s.u.)	19	8.16	8.03	8.31	N/A
Alkalinity	mg/L	18	138	141	159	0
Hardness	mg/L	19	690	685	765	0
TSS	mg/L	18	1	4	10	13
NO_3^-/NO_2^-	mg/L	18	12	12	15	0
NH_3	mg/L	15	0.050	0.050	0.050	15
SO_4^{2-}	mg/L	18	887.5	894	994	0
Cl^-	mg/L	18	3	2.9	3.4	0
TOTAL METALS						
Al	µg/L	18	5	14	55	1
As	µg/L	18	1.50	1.4	2.1	1
Cd	µg/L	18	0.55	0.49	0.7	0
Cu	µg/L	18	0.6	1.0	2.5	1
Cr (III/IV)	µg/L	17	0.50	0.51	0.54	16
Fe	µg/L	18	30	145	364.25	16
Pb	µg/L	18	0.050	0.056	0.10	16
Mn	µg/L	18	1	1	2	1
Hg	µg/L	18	0.050	0.050	0.050	18
Mo	µg/L	18	47	47	59	0
Ni	µg/L	17	1.3	1.9	5.3	0
Se	µg/L	18	34.5	35	44	0
Zn	µg/L	18	7	7	13	1
DISSOLVED METALS						
Al	µg/L	19	1	2	4	14
As	µg/L	19	1.50	1.4	2.1	1
Cd	µg/L	19	0.51	0.43	0.58	1
Cu	µg/L	19	0.4	0.7	0.58	0
Cr (III/IV)	µg/L	18	0.50	0.50	0.50	18
Fe	µg/L	19	30	39	47.3	18
Pb	µg/L	19	0.050	0.051	0.052	17
Mn	µg/L	19	1	1	2	4
Hg	µg/L	19	0.050	0.050	0.050	19
Mo	µg/L	16	47	46	58	0
Ni	µg/L	18	1.3	2.1	4.9	0
Se	µg/L	16	33	34	41	0
Zn	µg/L	19	8	8	19	1

The concentrations of metals in lower Buckskin Creek (Buck) are for the most part low. The only metals with elevated concentrations are selenium (35 µg/L), molybdenum (47 µg/L) and sulfate (894 mg/L) (Table 3.6-3). The concentrations of selenium are believed to be at a steady-state concentration after having increased since the early 1990s.

As a general point of comparison, the WQS for aquatic life for the concentration of total selenium is 20 µg/L for the acute (CMC) and 5 µg/L for the chronic (CCC) condition (Table 3.6-2). However, these WQSs do not apply to Buckskin Creek (see below for further discussion of this issue), which serves only to convey discharge from the sedimentation pond via Outfall 001 to Thompson Creek (receiving stream). The median, mean, and 95th percentiles for the concentrations of total selenium at the lowermost site, Buck (Figure 3.6-1., Table 3.6-3.), are all greater than the aquatic life standards. However, as noted previously, this water is actively managed as part of the mine water management system and WQSs do not apply to this stream above its confluence with Thompson Creek. The concentration of molybdenum appears to be increasing as with the concentrations of calcium and sulfate. There is no Idaho WQS for molybdenum.

Some amount of mine-affected groundwater (intercepted from the toe of the Buckskin WRSF) is discharged either to lower Buckskin Creek below Outfall 001 or to Thompson Creek directly. The water from Outfall 001 is subject to effluent limits for various constituents. The NPDES permit conditions contains different effluent limitations for each constituent for this outfall, depending upon whether Thompson Creek flows are greater or less than 7 cfs. The 7 cfs dilution trigger is to ensure there is adequate dilution of Outfall 001 releases, so that stream WQS are met in Thompson Creek.

Effluent limits may be greater than the in-stream standard because the effluent will be diluted by the receiving water. The 7 cfs trigger is a function of the establishment of a mixing zone within a specific distance downstream of the outfall, based upon modeling, to ensure aquatic life is protected even just below the outfall prior to complete mixing. As part of the permitting process, the IDEQ analyzes the mixing zone considering the chemistry of the receiving water, the biological condition of the zone, bioaccumulation factors, fish passage requirements, channel characteristics, and resultant effluent plume dispersion/dilution modeling. The NPDES permit limits are in part based on a 2000 mixing model (IDEQ 2000). Although the NPDES permit allows discharge from Outfall 001 when Thompson Creek flows are less than 7 cfs, not doing so provides additional insurance against in-stream exceedances of the selenium criterion.

Between January 2008 through December 2012, there were controlled discharges from Outfall 001 during 12 separate months. The effluent limits for regulated parameters were met during all discharges except for limits for selenium at Outfall 001 and total suspended solids (TSS) at Outfall 002 (ECHO database, EPA 2012a). Outfall 001 discharges are discussed below. Outfall 002 discharges are discussed in the Pat Hughes Creek section that follows.

In two of those months the concentrations of total selenium exceeded the applicable effluent limits (Table 3.6-4). As previously discussed, TCMC installed a pipeline in late 2011 to collect seepage water, thereby improving the water quality and eliminating exceedances of the selenium

WQS. There was no discharge from Outfall 001 between the time the pipeline was installed and the end of 2012.

Table 3.6-4. All exceedances, Outfalls 001 and 002.

Outfall	Month and Year	Parameter	Average Monthly Concentration		Maximum Daily Concentration	
			Reported Result	Effluent Limit	Reported Result	Effluent Limit
001	June 2009	Se (µ/L)	**53.5**	41	53.5	56
001	June 2011	Se (µ/L)	**60.25**	41	**63**	46
002	May 2008	TSS (mg/L)	9	20	**31**	30
002	Apr 2009	TSS (mg/L)	**43**	20	**111**	30
002	Apr 2012	TSS (mg/L)	**46**	20	**46**	30
002	May 2012	TSS (mg/L)	**44**	20	**44**	30

Values in **bold** indicate an exceedance of the effluent limit.

The WQSs do not list specific beneficial use designations for Buckskin Creek. However, as undesignated waters, cold water aquatic life and secondary contact recreation designated beneficial uses typically apply by default (Section 101, IDAPA 58.01.02). Accordingly, Buckskin Creek is identified as fully supporting its designated cold water aquatic life beneficial use (IDEQ 2011a) based on analyses of samples taken in 1998 under the IDEQ Beneficial Use Reconnaissance Program (BURP). The analyses were assessed in 2002, and are reflected in the most recent approved IR (IDEQ 2011a). However, the BURP protocols are for perennial streams and are not appropriate for streams with low or intermittent flow. Therefore, the IDEQ intends to administratively correct the status of Buckskin Creek in the 2014 IR by placing the stream assessment units in Category 4c: streams impaired by pollution, not *pollutants* (Saffle 2013). Such assessment precludes further assessment (beneficial use support) of the assessment unit, and does not require development of TMDLs. A TMDL is only established for pollutants such as sediment or temperature and not for pollution such as flow or habitat alteration. In summary, Buckskin Creek is considered by TCMC and the IDEQ to be a permanently highly perturbed, flow-altered stream whose flow and water quality is a result of mine operations in compliance with the NPDES permit (Saffle 2013).

The water quality in lower Pat Hughes Creek improves below the toe of the WRSF where seepage surfaces (site PH TOE, Section 3.6.1.2.). Water quality data for the watershed is from two surface water monitoring locations: PAT which represents water flowing into the sedimentation pond, and PATP which represents water in the pond. Comparing the medians of parameters analyzed from PATP with those from BUCK shows that hardness, alkalinity, and the concentration of sulfate are lower at PATP than at BUCK. The concentrations of selenium and molybdenum are also lower at PATP, as are the concentrations of several other trace metals (or metalloids), which at least in part indicates that water management strategies in the Pat Hughes watershed are generally meeting design objectives. The concentration of total selenium is often higher than the CCC at PAT and PATP, but such concentrations are in water actively managed by TCMC (Figure 3.6-1., Table 3.6-5).

Table 3.6-5. Pat Hughes Creek water quality, monitoring sites PAT and PATP.

		PAT						PATP					
Parameter	**Unit**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**
pH	s.u.	7.68	7.8	6.8	8.11	522	0	7.95	8.04	6.9	8.95	207	0
Alkalinity	mg/L	98.1	100	62.6	127	52	0	71.3	71	34.2	133	25	0
Hardness	mg/L	312	332	96.7	479	75	0	344	356	218	447	27	0
Turbidity	NTU	10.5	1	0	28.4	474	1	15.9	1.53	0	43.6	178	1
TSS	mg/L	27.8	10	1	19.2	59	45	11.3	10	10	19.6	27	19
TDS	mg/L	569	587	200	873	53	0	622	612	368	833	26	0
Cl^--T	mg/L	14	9.9	3.22	33.9	52	0	15.5	10	6	42.4	26	0
F^--T	mg/L	0.18	0.19	0.1	0.29	43	1	0.242	0.21	0.16	0.41	18	0
SO_4^{2-}	mg/L	326	334	102	505	538	0	347	328	185	548	209	0
NO_2^-/NO_3^-	mg/L	1.89	1.64	0.44	4.24	52	0	1.95	1.84	0.19	4.76	26	1
CONCENTRATIONS OF TOTAL METALS													
Al	µg/L	872	64	7	1000	53	0	209	62.5	10.3	670	26	0
As	µg/L	1.39	0.5	0.1	1.34	53	8	0.808	0.75	0.1	1.65	26	5
Ba	µg/L	58.4	54	20.6	85	53	0	52.2	49.2	24.4	75	26	0
Ca	mg/L	101	106	34.4	149	53	0	105	110	66.2	134	25	0
Cd	µg/L	0.31	0.07	0.02	1.52	53	15	0.312	0.16	0.05	1.56	26	5
Co	µg/L	1.21	0.4	0.1	6.1	44	1	0.883	0.45	0.2	3.13	18	0
Cr	µg/L	1.55	0.5	0.5	7.08	44	28	1.02	0.5	0.5	2.87	18	11
Cu	µg/L	2.7	0.9	0.1	5.72	53	4	2.13	1.95	0.67	4.4	26	1
Fe	µg/L	969	77	30	905	53	14	208	107	30	743	26	8
Hg	µg/L	0.05	0.05	0.05	0.1	53	52	0.057	0.05	0.05	0.1	26	25
K	mg/L	1.45	1	1	2.67	12	1	2.75	3	1.3	3.85	4	0
Mg	mg/L	18.7	20	7.2	29.8	53	0	21.1	22	11	26.8	25	0
Mn	µg/L	110	17.7	2.73	558	53	0	111	45	16.8	488	26	0
Mo	µg/L	12.3	8.05	4.47	18.1	53	0	13.8	12.4	5.84	35.5	26	0
Na	mg/L	43.1	45	18.4	68.1	53	0	51.4	51	31	68.8	25	0
Ni	µg/L	2.35	1.45	0.2	7.56	44	3	2.1	1.6	0.58	4.19	18	0
Pb	µg/L	3.08	0.15	0.05	2.27	53	15	0.59	0.27	0.05	1.76	26	3
Sb	µg/L	0.24	0.2	0.09	0.48	44	4	0.265	0.23	0.11	0.46	18	1
Se	µg/L	5.32	5	1	11.4	53	1	6.62	6.5	2.25	12	26	1

		PAT						PATP					
Parameter	**Unit**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**	**Mean**	**Median**	**5th %**	**95th %**	**Sample Count 2000-2010**	**Count < Detect.**
Zn	µg/L	24	5	2	93	53	1	17.2	11.3	2.85	63.2	26	0
CONCENTRATIONS OF DISSOLVED METALS													
Al	µg/L	8.87	4	1	30.5	54	14	12.5	6	1	48.2	28	4
As	µg/L	0.45	0.45	0.1	0.73	54	5	0.66	0.55	0.14	1.4	28	3
Ba	µg/L	48.4	51.2	15	74.7	54	0	48.4	48.5	17.9	66.6	28	0
Ca	mg/L	79.2	74	27	112	21	0	97.6	110	53.4	120	13	0
Cd	µg/L	0.42	0.05	0.05	1.64	54	31	0.31	0.06	0.01	1.29	28	12
Co	µg/L	0.74	0.2	0.1	1.7	45	10	0.565	0.3	0.1	2.09	20	0
Cr	µg/L	0.50	0.5	0.5	0.5	45	44	1.8	0.5	0.5	1.81	20	19
Cu	µg/L	0.76	0.60	0.10	2	54	7	1.6	1	0.2	4	28	1
Fe	µg/L	30.4	30	30	30	54	52	30	30	30	30	28	28
Hg	µg/L	0.05	0.05	0.05	0.05	51	51	0.05	0.05	0.05	0.05	26	26
K	mg/L	1.25	1	1	2	12	2	3	3	1.4	4.6	5	0
Mg	mg/L	14.7	13	5	23	21	0	21.3	22	9	38	13	0
Mn	µg/L	76.4	4.37	0.21	318	54	3	58	16	0.4	328	28	0
Mo	µg/L	8.48	8.42	4.43	11.9	21	0	18.4	13	9.18	45	13	0
Na	mg/L	34.9	37	17	58	21	0	48.4	49	23.2	64.2	13	0
Ni	µg/L	1.32	0.9	0.1	3.84	45	4	1.54	1.05	0.58	4.11	20	1
Pb	µg/L	0.05	0.05	0.05	0.107	54	48	0.062	0.05	0.05	0.07	28	24
Sb	µg/L	0.17	0.14	0.05	0.288	45	4	0.18	0.15	0.05	0.30	20	2
Se	µg/L	5.87	5	1	13.8	23	2	7.38	7	3.4	12.4	13	1
Zn	µg/L	15.4	4	2	63.2	54	7	12.1	4	1.3	46.6	28	3

During the most recent regulatory period (January 2008 through December 2012), there were controlled discharges from Outfall 002 (lower Pat Hughes Creek) during 11 separate months. The effluent limits for regulated parameters were met during all discharges except for TSS during four of the months (ECHO database, EPA 2012a) (Table 3.6-4). Pat Hughes Creek is listed as not having been assessed in the latest IR (IDEQ 2011a). Like Buckskin Creek, Pat Hughes Creek is considered to be a permanently highly perturbed, flow-altered stream whose flow and water quality is the result of mine operations in compliance with the NPDES permit (Saffle 2013). Accordingly, the IDEQ intends to administratively correct the status of Pat Hughes Creek in the 2014 listing by placing the stream assessment units in Category 4c: streams impaired by pollution, not *pollutants* (Saffle 2013).

Thompson Creek is the receiving stream for both Buckskin and Pat Hughes creeks. TCMC has monitored the water quality of Thompson Creek upstream of Buckskin Creek (i.e., upstream of all of the mine operations), as well as at several downgradient sites (Figure 3.6-1). Site TC4 is the upgradient site. Water at this site has good quality, except that unlike most trace metals, the background concentrations of molybdenum are above the laboratory detection limit. The concentration varies seasonally, averaging 0.7 µg/L during snowmelt run-off, and 2.3 µg/L during base flow. The concentrations of selenium are almost always 1 µg/L or less, but on occasion have reached 2 µg/L. Total dissolved solids (TDS), conductivity, hardness, and the concentrations of sulfate, nitrate, barium, molybdenum, and selenium are all higher at TC3 than at TC4 (Table 3.6-6). The higher values for these parameters are attributed primarily to contributions previously noted in the mine-affected tributary (Buckskin Creek).

Of these parameters, only the concentration of selenium at TC3 has exceeded the water quality criteria for aquatic life (the concentration of selenium at TC4 is consistently at or below the detection limit of 1 µg/L). The concentration of selenium at TC3 has increased to a mean of 4.4 µg/L during the baseflow season since 2000, and at TC1 (the lowermost site on Thompson Creek) the concentration decreases to between 2 µg/L and 4 µg/L. At TC3 the concentration of selenium equaled or exceeded the CCC of 5 µg/L during low flow periods during 2000 to 2004. However, since 2005, when TCMC implemented the previously mentioned water management strategy of discharging from Outfall 001 only when flow in Thompson Creek is at least 7 cfs, the concentration of selenium at TC3 has not exceeded the CCC of 5 µg/L. Concentrations of selenium equal to 5 µg/L were measured in samples from TC3 during three sampling events (August 2006, October 2006, and October 2009) during 2005 to 2010. All other measured concentrations of selenium were between 2 µg/L and 4 µg/L at TC3. The median concentration of selenium at TC3 is 3 µg/L (Table 3.6-6).

As previously noted, the water quality of Thompson Creek is not impaired upstream or downstream of the mine. The WQSs list cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses for Thompson Creek. The most recent approved IR considers Thompson Creek as fully supporting its cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses (IDEQ 2011a).

Table 3.6-6. Thompson Creek water quality, TC3.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	128	0	7.8	8.2
Alkalinity	mg/L	1	54	0	51	61
Hardness	mg/L	1	54	0	88	141
TDS	mg/L	5	54	0	165	255
Conductivity[5]	µS/cm	1	119	0	234	381
Nutrients						
NH_3	mg/L	0.05	14	13	0.05	0.06
NO_3^-	mg/L	0.05	54	0	0.63	1.24
Anions						
Cl^-	mg/L	1	54	43	1.0	1.3
F^-	mg/L	0.1	46	23	0.1	0.1
SO_4^{2-}	mg/L	1	54	0	61	121
Metals						
Al-total (T)	µg/L	1	54	0	40	552
Al-dissolved (D)	µg/L	1	53	5	5	111
As-T	µg/L	0.1	54	6	0.5	1.0
As-D	µg/L	0.1	54	4	0.5	0.7
Cd-T	µg/L	0.05	53	26	0.05	0.14
Cd-D	µg/L	0.05	53	38	0.05	0.07
Cr-T	µg/L	0.5	46	33	0.5	1.3
Cr-D	µg/L	0.5	46	45	0.5	0.5
Cu-T	µg/L	0.1	54	7	0.4	2.0
Cu-D	µg/L	0.1	54	11	0.3	0.6
Fe-T	µg/L	30	54	25	37	500
Fe-D	µg/L	30	54	42	30	73
Pb-T	µg/L	0.05	54	38	0.05	0.32
Pb-D	µg/L	0.05	53	51	0.05	0.05
Mn-T	µg/L	0.05	53	1	1.10	12.60
Mn-D	µg/L	0.05	54	9	0.20	0.89
Mo-T	µg/L	0.1	54	0	3.97	6.48
Mo-D	µg/L	0.1	21	0	3.82	5.24
Ni-T	µg/L	0.1	46	3	0.5	1.1
Ni-D	µg/L	0.1	46	5	0.4	0.8
Se-T	µg/L	1	58	2	3.0	6.0
Se-D	µg/L	1	21	2	3.0	6.0

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Zn-T	µg/L	2	54	12	3.0	7.3
Zn-D	µg/L	2	54	20	2.0	4.0

[1] Most common detection limit. Some detection limits changed between sample events.
[2] number of data points
[3] number of results below their detection limit
[4] Median and 95th percentile were calculated after results that were less than their detection limits were set equal to the detection limit.
[5] field measurements

Water in the TSF (tailings pond and tailings solids) has elevated hardness and elevated concentrations of sulfate, chloride, molybdenum, iron, manganese, and arsenic. It is important to note that water managed in the TSF has no surface discharge to middle or lower Bruno Creek. In addition, the water quality in lower Bruno Creek is believed to be influenced by non-TCMC mining activity, i.e., water discharged from the Twin Apex mine has elevated concentrations of antimony, cadmium, lead, and zinc (based upon a single sample).

Although the tailings water is not discharged via the surface to Bruno Creek, some seepage from the TSF may be entering Bruno Creek. Seepage is inferred to be migrating underground from the TSF eastward into Redbird Creek (Section 3.6.1.2.). Water quality data for Redbird Creek and Bruno Creek (Outfall 003) show no exceedances of WQSs at either of these sites at the 95th percentile (Table 3.6-7., Table 3.6-8). However, molybdenum concentrations in Redbird Creek have increased roughly by a factor of two since 2000 (data collection began at the end of 1998), current concentrations in Redbird Creek are typically between 2 to 3 µg/L. Sulfate concentrations in Redbird Creek have increased by a factor of approximately three, to values approaching 200 mg/L over the previous 10 + years. These and other data support the inference that seepage began influencing Redbird Creek in 1999 or 2000. Water quality data for the SQ3 and SQ2 sites complies with all applicable WQSs (Table 3.6-9., Table 3.6-10).

The WQSs do not list specific beneficial use standards for Bruno or Redbird creeks. However, as undesignated waters, cold water aquatic life and recreation designated beneficial uses apply by default. Bruno Creek is 303(d)-listed for not supporting cold water aquatic life or salmonid spawning due to combined biota/habitat bioassessments (IDEQ 2011a). The 1980 EIS described a number of probable significant effects to Bruno Creek and its aquatic resources (USFS 1980, pp. 5-13, 5-14). For example, the EIS described how the TSF would cause substantial reductions in flow in Bruno Creek downstream with a corresponding increase in water temperature. Such changes would result in the loss of the aquatic resources in Bruno Creek downstream of the TSF. TCMC mitigated these losses by supporting development of anadromous fish habitat in S. Creek. Note that these losses were not due to any of the pollutants (e.g., elevated metals) discussed above.

As with Thompson Creek, the water quality of S. Creek has been monitored for a number of years, both upstream (SQ3) and downstream (SQ2) of the mine operations (Figure 3.6-1). Water quality data indicate slightly alkaline water (~ pH 8.0). Concentrations of constituents vary with flow and are higher during base flow and lower during spring snowmelt (Table 3.6-9., Table 3.6-10). The water quality is not impaired upstream or downstream of the mine.

Table 3.6-7. Redbird Creek water quality, RB1.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	30	0	8.2	8.5
Alkalinity	mg/L	1	28	0	161	183
Hardness	mg/L	1	28	0	331	365
TDS	mg/L	5	28	0	456	505
Conductivity[5]	µS/cm	1	25	0	358	828
Nutrients						
NH_3	mg/L	0.05	11	11	0.05	0.05
NO_3^-	mg/L	0.05	28	25.0	0.05	0.05
Anions						
Cl^-	mg/L	1	27	0	32.0	39.2
F^-	mg/L	0.1	21	0	0.2	0.2
SO_4^{2-}	mg/L	1	27	0	133	194
Metals						
Al-T	µg/L	1	28	1	74	231
Al-D	µg/L	1	28	10	1	32
As-T	µg/L	0.1	28	9	0.4	0.5
As-D	µg/L	0.1	28	3	0.4	0.6
Cd-T	µg/L	0.05	28	23	0.05	0.11
Cd-D	µg/L	0.05	28	28	0.05	0.05
Cr-T	µg/L	0.5	21	17	0.5	3.0
Cr-D	µg/L	0.5	21	21	0.5	0.5
Cu-T	µg/L	0.1	28	6	0.7	3.0
Cu-D	µg/L	0.1	27	9	0.2	0.9
Fe-T	µg/L	30	28	9	45	143
Fe-D	µg/L	30	28	28	30	30
Pb-T	µg/L	0.05	28	9	0.07	0.64
Pb-D	µg/L	0.05	28	25	0.05	0.06
Mn-T	µg/L	0.05	28	0	2.83	6.06
Mn-D	µg/L	0.05	28	14	0.20	0.68
Mo-T	µg/L	0.1	27	0	1.91	2.56
Mo-D	µg/L	0.1	19	0	2.04	2.26
Ni-T	µg/L	0.1	21	4	0.2	5.3
Ni-D	µg/L	0.1	21	10	0.1	2.1
Se-T	µg/L	1	27	27	1.0	1.0
Se-D	µg/L	1	19	19	1.0	1.0
Zn-T	µg/L	2	28	9	2.0	10.9
Zn-D	µg/L	2	28	14	2.0	4.0

Footnotes – see Table 3.6-6.

Table 3.6-8. Bruno Creek water quality, Outfall 003.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	127	0	7.9	8.1
Alkalinity	mg/L	1	28	0	228	271
Hardness	mg/L	1	108	0	353	395
TDS	mg/L	5	28	0	420	452
Conductivity[5]	µS/cm	1	123	0	528	792
Nutrients						
NH_3	mg/L	0.05	10	10	0.05	0.05
NO_3^-	mg/L	0.05	28	5.0	0.07	0.16
Anions						
Cl^-	mg/L	1	28	0	27.0	39.2
F^-	mg/L	0.1	19	0	0.3	0.3
SO_4^{2-}	mg/L	1	28	0	99	128
Metals						
Al-T	µg/L	1	28	2	3	12
Al-D	µg/L	1	27	18	1	3
As-T	µg/L	0.1	27	0	1.2	1.6
As-D	µg/L	0.1	28	0	1.2	1.5
Cd-T	µg/L	0.05	22	3	0.10	0.38
Cd-D	µg/L	0.05	28	17	0.05	0.11
Cr-T	µg/L	0.5	19	12	0.5	4.4
Cr-D	µg/L	0.5	19	17	0.5	1.0
Cu-T	µg/L	0.1	22	9	0.1	0.5
Cu-D	µg/L	0.1	26	9	0.3	0.5
Fe-T	µg/L	30	28	23	30	43
Fe-D	µg/L	30	28	28	30	30
Pb-T	µg/L	0.05	23	0	0.30	0.93
Pb-D	µg/L	0.05	27	19	0.05	0.18
Mn-T	µg/L	0.05	28	0	8.65	15.28
Mn-D	µg/L	0.05	28	2	5.33	9.79
Mo-T	µg/L	0.1	23	0	10.70	11.58
Mo-D	µg/L	0.1	19	0	10.50	12.13
Ni-T	µg/L	0.1	19	0	2.0	3.1
Ni-D	µg/L	0.1	19	0	1.8	2.6
Se-T	µg/L	1	23	14	1.0	2.0
Se-D	µg/L	1	20	15	1.0	2.0
Zn-T	µg/L	2	22	0	16.0	19.0
Zn-D	µg/L	2	28	0	12.0	18.1

Footnotes – see Table 3.6-6.

Table 3.6-9. S. Creek water quality, SQ3.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	117	0	8.0	8.2
Alkalinity	mg/L	1	49	0	83	108
Hardness	mg/L	1	49	0	108	169
TDS	mg/L	5	49	0	175	246
Conductivity[5]	µS/cm	1	111	0	210	405
Nutrients						
NH_3	mg/L	0.05	11	11	0.05	0.05
NO_3^-	mg/L	0.05	49	38	0.05	0.09
Anions						
Cl^-	mg/L	1	49	2	7.9	13.0
F^-	mg/L	0.1	42	7	0.1	0.2
SO_4^{2-}	mg/L	1	49	0	31	64
Metals						
Al-T	µg/L	1	49	0	161	1530
Al-D	µg/L	1	48	8	7	202
As-T	µg/L	0.1	49	2	0.6	1.5
As-D	µg/L	0.1	49	2	0.6	0.8
Cd-T	µg/L	0.05	49	43	0.05	0.07
Cd-D	µg/L	0.05	49	48	0.05	0.05
Cr-T	µg/L	0.5	42	28	0.7	2.0
Cr-D	µg/L	0.5	42	36	0.5	0.6
Cu-T	µg/L	0.1	49	5	0.4	3.2
Cu-D	µg/L	0.1	47	13	0.2	0.7
Fe-T	µg/L	30	49	11	143	1102
Fe-D	µg/L	30	49	27	30	139
Pb-T	µg/L	0.05	49	0	0.39	1.53
Pb-D	µg/L	0.05	49	32	0.05	0.13
Mn-T	µg/L	0.05	49	0	7.65	29.76
Mn-D	µg/L	0.05	49	1	1.36	3.88
Mo-T	µg/L	0.1	49	0	1.29	1.87
Mo-D	µg/L	0.1	19	0	1.29	2.13
Ni-T	µg/L	0.1	42	0	0.7	1.8
Ni-D	µg/L	0.1	42	2	0.5	1.1
Se-T	µg/L	1	49	49	1.0	1.0
Se-D	µg/L	1	19	19	1.0	1.0
Zn-T	µg/L	2	49	14	2.0	6.2
Zn-D	µg/L	2	46	24	2.0	3.0

Footnotes – see Table 3.6-6.

Table 3.6-10. S. Creek water quality data, SQ2.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	123	0	8.0	8.3
Alkalinity	mg/L	1	47	0	94	122
Hardness	mg/L	1	47	0	128	186
TDS	mg/L	5	47	0	191	258
Conductivity[5]	µS/cm	1	117	0	235	439
Nutrients						
NH_3	mg/L	0.05	11	11	0.05	0.05
NO_3^-	mg/L	0.05	47	35	0.05	0.08
Anions						
Cl^-	mg/L	1	47	0	9.0	14.3
F^-	mg/L	0.1	40	5	0.1	0.2
SO_4^{2-}	mg/L	1	47	0	36	69
Metals						
Al-T	µg/L	1	47	0	126	1287
Al-D	µg/L	1	47	10	7	187
As-T	µg/L	0.1	47	5	0.6	1.3
As-D	µg/L	0.1	47	0	0.6	0.9
Cd-T	µg/L	0.05	47	39	0.05	0.08
Cd-D	µg/L	0.05	47	45	0.05	0.05
Cr-T	µg/L	0.5	40	14	0.7	4.0
Cr-D	µg/L	0.5	40	35	0.5	0.9
Cu-T	µg/L	0.1	47	4	0.6	3.2
Cu-D	µg/L	0.1	46	6	0.3	0.6
Fe-T	µg/L	30	47	12	121	844
Fe-D	µg/L	30	47	31	30	105
Pb-T	µg/L	0.05	47	0	0.43	2.01
Pb-D	µg/L	0.05	47	30	0.05	0.13
Mn-T	µg/L	0.05	47	0	6.40	25.03
Mn-D	µg/L	0.05	47	1	1.02	2.44
Mo-T	µg/L	0.1	47	0	1.78	2.79
Mo-D	µg/L	0.1	19	0	1.98	2.68
Ni-T	µg/L	0.1	40	0	0.8	1.7
Ni-D	µg/L	0.1	40	2	0.4	1.2
Se-T	µg/L	1	47	48	1.0	1.0
Se-D	µg/L	1	19	19	1.0	1.0
Zn-T	µg/L	2	47	5	3.0	6.7
Zn-D	µg/L	2	45	20	2.0	3.8

Footnotes – see Table 3.6-6.

The WQSs list cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses for S. Creek. The stream, as it flows past Redbird Creek and Bruno Creek to its (S. Creek) mouth, fully supports its designated cold water aquatic life beneficial uses (IDEQ 2012a). Salmonid spawning and secondary contact recreation were not assessed in the 2010 IR (IDEQ 2011a).

The Salmon River is also monitored upstream (SR3) and downstream (SR1) of the mine, i.e., upstream of the mouth of Thompson Creek and downstream of the mouth of S. Creek (Figure 3.6-1). Only the concentrations of sulfate and barium are slightly higher in the Salmon River at SR1 compared to their concentrations at SR3. For example, upstream of the mouth of Thompson Creek, the concentrations of sulfate at SR3 typically fluctuate between 4 µg/L and 6 µg/L; downstream of the mine, the concentrations of sulfate at SR1 fluctuate between 5 µg/L and 9 µg/L. Based upon these data, the water quality at both of the Salmon River monitoring sites meets all WQSs (Table 3.6-11., Table 3.6-12).

The WQSs list cold water aquatic life, salmonid spawning, primary contact recreation, and domestic water supply as designated beneficial uses for the Salmon River downstream of Thompson Creek. The most recent approved IR considers the Salmon River downstream of S. Creek to fully support the cold water aquatic life and primary contact recreation beneficial uses of the Salmon River; support for salmonid spawning uses was not assessed (IDEQ 2011a). Between the mouths of Thompson and S. creeks, the Salmon River is 303(d)-listed for not supporting its cold water aquatic life beneficial uses due to sedimentation/siltation and water temperature (IDEQ 2011a). The ability of this section of the Salmon River to support the beneficial uses of domestic water supply, primary contact recreation, and salmonid spawning has not been assessed to date. Upstream of Thompson Creek, the Salmon River fully supports all of its beneficial uses (i.e., cold water aquatic life, primary contact recreation, salmonid spawning, and domestic water supply) (IDEQ 2011a). The TSS and turbidity monitoring data collected from samples of Thompson Creek downstream of Pat Hughes Creek indicate that the mine is not contributing sediment to the Salmon River downstream of Thompson Creek.

Table 3.6-11. Salmon River water quality, SR3.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	14	0	7.9	8.4
Alkalinity	mg/L	1	14	0	52	60
Hardness	mg/L	1	14	0	52	62
TDS	mg/L	5	14	0	74	92
Conductivity[5]	µS/cm	1	14	0	131	152
Nutrients						
NH_3	mg/L	0.05	2	2	0.05	0.05
NO_3^-	mg/L	0.05	14	12	0.05	0.07
Anions						
Cl^-	mg/L	1	14	8	1.0	2.4
F^-	mg/L	0.1	14	0	0.6	0.8
SO_4^{2-}	mg/L	1	14	0	5	7
Metals						
Al-T	µg/L	1	14	0	170	1263
Al-D	µg/L	1	14	0	11	80
As-T	µg/L	0.1	14	0	1.9	2.1
As-D	µg/L	0.1	14	0	1.4	1.6
Cd-T	µg/L	0.05	14	11	0.05	0.31
Cd-D	µg/L	0.05	14	14	0.05	0.05
Cr-T	µg/L	0.5	14	3	0.7	2.2
Cr-D	µg/L	0.5	14	13	0.5	0.7
Cu-T	µg/L	0.1	14	2	0.6	1.8
Cu-D	µg/L	0.1	14	6	0.2	0.4
Fe-T	µg/L	30	14	2	137	894
Fe-D	µg/L	30	14	11	30	73
Pb-T	µg/L	0.05	14	1	0.17	0.90
Pb-D	µg/L	0.05	14	3	0.05	0.09
Mn-T	µg/L	0.05	14	0	8.35	38.40
Mn-D	µg/L	0.05	14	3	0.55	1.75
Mo-T	µg/L	0.1	14	0	2.62	3.03
Mo-D	µg/L	0.1	2	0	2.46	2.77
Ni-T	µg/L	0.1	14	2	0.4	0.9
Ni-D	µg/L	0.1	14	8	0.1	0.6
Se-T	µg/L	1	14	14	1.0	1.0
Se-D	µg/L	1	2	2	1.0	1.0
Zn-T	µg/L	2	14	3	4.0	6.4
Zn-D	µg/L	2	14	9	2.0	4.0

Footnotes – see Table 3.6-6.

Table 3.6-12. Salmon River water quality, SR1.

Parameter	Unit	DL[1]	N[2]	N<DL[3]	Median[4]	95th %[4]
Physical						
pH[5]	s.u.	0.1	14	0	8.0	8.4
Alkalinity	mg/L	1	14	0	53	62
Hardness	mg/L	1	14	0	57	64
TDS	mg/L	5	14	0	78	101
Conductivity[5]	µS/cm	1	13	0	139	158
Nutrients						
NH_3	mg/L	0.05	2	2	0.05	0.05
NO_3^-	mg/L	0.05	14	13	0.05	0.05
Anions						
Cl^-	mg/L	1	14	8	1.0	2.4
F^-	mg/L	0.1	14	0	0.6	0.7
SO_4^{2-}	mg/L	1	14	0	7	9
Metals						
Al-T	µg/L	1	14	0	171	1638
Al-D	µg/L	1	14	1	8	83
As-T	µg/L	0.1	14	0	1.9	2.1
As-D	µg/L	0.1	14	0	1.4	1.6
Cd-T	µg/L	0.05	14	12	0.05	0.20
Cd-D	µg/L	0.05	14	14	0.05	0.05
Cr-T	µg/L	0.5	14	4	0.6	1.5
Cr-D	µg/L	0.5	14	14	0.5	0.5
Cu-T	µg/L	0.1	14	3	0.5	2.6
Cu-D	µg/L	0.1	14	3	0.2	0.6
Fe-T	µg/L	30	14	2	125	1095
Fe-D	µg/L	30	13	10	30	71
Pb-T	µg/L	0.05	14	2	0.22	1.60
Pb-D	µg/L	0.05	14	9	0.05	0.09
Mn-T	µg/L	0.05	14	0	8.32	45.10
Mn-D	µg/L	0.05	14	2	0.46	1.40
Mo-T	µg/L	0.1	14	0	2.57	2.94
Mo-D	µg/L	0.1	2	0	2.58	2.87
Nil-T	µg/L	0.1	14	1	0.5	1.2
Ni-D	µg/L	0.1	14	8	0.1	0.7
Se-T	µg/L	1	14	14	1.0	1.0
Se-D	µg/L	1	2	2	1.0	1.0
Zn-T	µg/L	2	14	3	4.0	8.1
Zn-D	µg/L	2	14	8	2.5	4.7

Footnotes – see Table 3.6-6.

The aforementioned 10 year data set for the receiving streams was used to establish a conservative baseline water chemistry (95th percentile of the data collected in the low flow season of September through March, Table 3.6-13.) against which to compare predicted water quality. Three monitoring sites were used to best represent receiving stream conditions. TC4 (in Thompson Creek) and SR3 (in the Salmon River) are upstream of and presumably unaffected by the mine. SQ2 (in S. Creek) is downstream of Redbird and Bruno creeks and could be influenced by the mine. Although SQ3 is further upstream than SQ2 (also in S. Creek), it is still downstream of Redbird Creek, thus there are no true background sites for the S. Creek analysis. Use of SQ2 is likely more conservative because it is further downstream.

Table 3.6-13. Baseline water quality in Thompson Crk., S. Crk., and Salmon R.

			Thompson Creek (TC4)		S. Creek (SQ2)		Salmon River (SR3)	
Parameter	**Unit**	**DL[1]**	**N[2]**	**95th %[3]**	**N**	**95th %**	**N**	**95th %**
Field measurements								
mol/L		0.1	72	8.2	71	8.3	3	8.0
Conductivity	µS/cm	1	63	148	65	454	3	155
Turbidity	NTU	0.05	64	48.5	65	23.8	3	0.8
Physical								
Alkalinity-T	mg/L	1	19	50	17	123	4	64
Hardness-T	mg/L	1	19	52	17	190	4	62
TDS	mg/L	5	19	92	17	262	4	89
TSS	mg/L	10	19	10.0	17	10.0	4	10.0
Nutrients								
NH_3	mg/L	0.05	8	0.05	6	0.05	1	0.05
NO_2^-	mg/L	0.01	6	0.01	6	0.01	1	0.01
NO_3^-	mg/L	0.05	19	0.081	17	0.148	4	0.076
P-T	mg/L	0.01	19	0.030	17	0.047	4	0.016
Major ions								
Ca^{2+}	mg/L	1	19	16.2	17	46.4	4	21.9
Mg^{2+}	mg/L	0.5	19	3.0	17	18.2	4	2.0
K^+	mg/L	1	8	1.7	6	2.0	1	1.0
Na^+	mg/L	1	19	6.0	17	12.2	4	5.9
Br^-	mg/L	0.5	8	0.50	6	0.50	1	0.50
Cl^-	mg/L	1	19	1.00	17	15.04	4	1.00
F^-	mg/L	0.1	15	0.11	14	0.20	4	0.70
SO_4^{2-}	mg/L	1	19	14.10	17	75.40	4	8.55
Metals								
Al-T	µg/L	1	19	86.5	17	175.4	4	179.0
Al-D	µg/L	1	19	8.8	17	25.8	4	10.6

			Thompson Creek (TC4)		S. Creek (SQ2)		Salmon River (SR3)	
Parameter	**Unit**	**DL[1]**	**N[2]**	**95th %[3]**	**N**	**95th %**	**N**	**95th %**
Sb-T	µg/L	0.05	15	0.10	13	0.13	4	0.16
Sb-D	µg/L	0.05	15	0.06	13	0.11	4	0.12
As-T	µg/L	0.1	19	0.85	17	1.44	4	1.77
As-D	µg/L	0.1	19	0.51	17	0.96	4	1.57
Ba-T	µg/L	0.5	19	6.79	17	32.42	4	6.53
Ba-D	µg/L	0.5	19	6.51	17	31.08	4	5.91
Be-T	µg/L		8	1.00	6	1.00	1	1.00
Be-D	µg/L		8	1.00	6	1.00	1	1.00
Cd-T	µg/L	0.05	19	0.050	17	0.080	4	0.050
Cd-D	µg/L	0.05	19	0.050	17	0.050	4	0.050
Cr-T	µg/L	0.5	15	1.76	14	2.03	4	1.85
Cr-D	µg/L	0.5	15	0.50	14	1.01	4	0.50
Co-T	µg/L	0.1	15	0.10	13	0.20	4	0.10
Co-D	µg/L	0.1	15	0.10	13	0.14	4	0.10
Cu-T	µg/L	0.1	19	0.85	17	2.04	4	1.07
Cu-D	µg/L	0.1	19	0.81	16	0.53	4	0.40
Fe-T	µg/L	30	19	64.7	17	123.6	4	138.3
Fe-D	µg/L	30	19	30.0	17	30.0	4	30.0
Pb-T	µg/L	0.05	19	0.118	17	0.778	4	0.190
Pb-D	µg/L	0.05	19	0.075	17	0.102	4	0.050
Mn-T	µg/L	0.05	19	2.12	17	6.48	4	8.98
Mn-D	µg/L	0.05	19	0.48	17	2.51	4	1.87
Hg-T	µg/L	0.0001	7	0.00064	7	0.00077	2	0.00070
Hg-D	µg/L	0.05	0		0		0	
Mo-T	µg/L	0.1	19	2.18	17	2.83	4	2.87
Mo-D	µg/L	0.1	10	2.07	10	2.80	1	2.80
Ni-T	µg/L	0.1	15	0.66	14	1.28	4	0.60
Ni-D	µg/L	0.1	15	0.46	14	1.34	4	0.60
Se-T	µg/L	1	22	1.95	17	1.00	4	1.00
Se-D	µg/L	1	11	2.00	10	1.00	1	1.00
Ag-T	µg/L	0.03	15	0.072	14	0.074	4	0.056
Ag-D	µg/L	0.03	15	0.051	14	0.055	4	0.030
Tl-T	µg/L	0.5	8	0.50	6	0.50	1	0.50
Tl-D	µg/L	0.5	8	0.50	6	0.50	1	0.50
U-T	µg/L	1	8	1.00	6	1.00	1	2.00
U-D	µg/L	1	8	1.00	6	1.00	1	2.00
V-T	µg/L	1	8	2.00	6	2.00	1	1.00
V-D	µg/L	1	8	2.00	6	2.00	1	1.00

			Thompson Creek (TC4)		S. Creek (SQ2)		Salmon River (SR3)	
Parameter	**Unit**	**DL[1]**	**N[2]**	**95th %[3]**	**N**	**95th %**	**N**	**95th %**
Zn-T	µg/L	2	19	6.01	17	4.02	4	5.70
Zn-D	µg/L	2	19	3.00	16	2.50	4	3.70

[1] detection limit
[2] number of samples
[3] 95th percentile

In addition to the numeric WQSs, an antidegradation policy is also relevant to TCMC receiving streams. As part of the WQSs (IDAPA 58.01.02.051) three categories (Tiers I, II, and III) of waters are recognized. Tier II is the category relevant to Thompson Creek, S. Creek, and the Salmon River. Tier II waters are streams where the current water quality is better than the quality necessary to support beneficial uses. Under the existing antidegradation policy, point-source discharges may only lower water quality in Tier II waters after a public review of the social and economic tradeoffs of doing so. In other words, even if there is enough assimilation capacity to allow water quality degradation and still meet the beneficial use standards of the stream, it is not necessarily allowable to do so. Where possible, the intent is to maintain the highest water quality and conserve assimilation capacity. The antidegradation policy is addressed under the NPDES permit program (as well as other CWA requirements including Section 401c and Section 404). Point-source discharges must undergo antidegradation review whenever there is an application for a new or renewed NPDES permit. The antidegradation policy would also apply to any applications for 404 permits for the mine.

The above discussions have generally focused upon base flow conditions during which there is less dilution capacity and thus the potential for highest concentrations of trace elements. However, the concentration of TSS tends to increase during the run-off season and is also subject to NPDES effluent limitations (10 mg/L). Weekly TSS monitoring at Outfalls 001, 002, and 003 indicates that concentrations of TSS are almost always reported as less than 10 mg/L. Concentrations greater than 10 mg/L are reported even more rarely at these sites (see previous discussion in this section). Turbidity is also generally low at these outfalls. Together, this information indicates that TCMC has been successful at controlling sediment generated by the mine, typically minimizing TSS contributions to, and turbidity in, Buckskin, Pat Hughes, and Bruno creeks. The few exceedances that have occurred were during spring run-off when all streams in the region were carrying relatively high amounts of sediment.

Monthly TSS and turbidity records for the upstream Thompson Creek site (TC4) show concentrations of TSS at less than 10 mg/L and turbidity averaging 6.5 nephelometric turbidity units (NTUs). The records for sites in lower Thompson Creek show similar results and indicate excellent control of sediment at the mine. The records for the site for S. Creek also show that TSS is most often less than 10 mg/L and turbidity averages 7.4 NTUs. Monthly records of the concentration of TSS and the turbidity in the Salmon River show values similar to those for the tributary streams (Thompson Creek and S. Creek).

Surface Water Rights

There are numerous water rights for streams in the analysis area, many of which are owned by TCMC or the BLM. TCMC has water rights for a portion of the flow in Buckskin Creek (72-07552, combined with 72-07553 into 72-7193 in 2006), Pat Hughes Creek (72-07553), Thompson Creek, Bruno Creek, S. Creek, and the Salmon River (72-7193, 1981), and two springs in the Buckskin watershed. These three water rights allow for the effective de-watering of Buckskin Creek and Pat Hughes Creek. The three water rights total 20.86 cfs with the allowable beneficial uses as industrial and irrigation (IDWR 2012).

The BLM water rights are for a portion of the flow in Buckskin Creek, Pat Hughes Creek, the unnamed drainage channel east of Pat Hughes Creek, Thompson Creek, and the Salmon River. The water is used for stock watering. The Forest Service has water rights for stock watering along upper Thompson Creek and S. Creek. Idaho has water rights for a portion of S. Creek for fish propagation. There are numerous privately owned water rights for water from near the mouths of Thompson Creek and S. Creek as well as from the Salmon River for irrigation.

Most BLM land, including the selected land, is subject to Executive Order *Public Water Reserves [PWRs] No. 107*. Under the Executive Order, the BLM reserves a limited quantity of water from natural springs and water holes found on such lands for public uses for domestic human consumption and stock watering. A PWR cannot be transferred, even if the land on which it occurs will leave Federal ownership; instead, a PWR must be revoked. The BLM has inventoried the selected land for public water reserves, and all of the reserves were revoked (76 FR 38206).

3.6.1.2. Groundwater

In general, the higher elevation portions in the north of the analysis area are groundwater recharge areas, and the lower elevations in the south are groundwater discharge areas. Consequently, groundwater movement is generally from north to south. Bedrock geology controls groundwater movement in the analysis area. The porosity of a geologic unit is the amount of void space available. The permeability of a geologic unit is the ability of the unit to allow fluids to pass through it. The hydraulic conductivity of a geologic unit is a measure of how easily water moves through it, a function of the permeability of the unit and the properties of the fluid.

The bedrock in the analysis area has primary porosity from the space between the particles that make up the rock, and considerable secondary porosity from space due to fractures. However, in general, groundwater is limited to depths of less than 2,500 feet from the ground surface due to the weight of the overlying rock which does not allow fractures to open (e.g., Nelson 2011). Most groundwater movement in the analysis area is through fractured bedrock, particularly along the contacts between rock units. However, there is also substantial groundwater movement through the relatively thin (but highly permeable) colluvium and alluvium found at the surface or, in some cases, between bedrock formations.

The Copper Basin Formation (metasedimentary rock underlying the entire analysis area except where intruded by the Thompson Creek intrusive complex and the Challis Volcanic Group) has an estimated mean hydraulic conductivity of 2.7 feet per day. The Thompson Creek intrusive

complex has an estimated mean hydraulic conductivity of 1.5 feet per day. The Challis Volcanic Group, the youngest rocks in the area, is locally continuous, and follows the topography where present. These rocks have an estimated mean hydraulic conductivity of 0.56 feet per day. The hydraulic conductivity has not been estimated for the Saturday Mountain Formation (metasedimentary rock, same depositional setting as that of the Copper Basin Formation). A thin veneer of alluvial and colluvial deposits overlies these bedrock units in places. The thickness of the alluvial and colluvial deposits is greatest in the valley bottoms where the deposits are the primary aquifers. These deposits have an estimated mean hydraulic conductivity of 20.3 feet per day.

Buckskin Creek Basin

The Buckskin WRSF is the primary storage site for non-acid-generating waste rock (Type 1), but some potentially acid-generating waste rock (Type 2) is also in the WRSF. A perforated underdrain was constructed under the WRSF to promote rapid lateral drainage of seepage from along the base of the facility to minimize infiltration of the seepage into groundwater. A relatively thin layer of unconsolidated colluvium and alluvium covers the surface of the middle and lower Buckskin watershed. Below the downgradient face of the WRSF and downgradient of the sedimentation pond there are places where volcanic rocks (Challis Volcanic Group) are just below the unconsolidated deposits. Both of these units are underlain by metasedimentary rocks (Copper Basin Formation), except for a small area below the upper section of the WRSF underlain by a thin lens of Thompson Creek intrusive rock (Figure 3.6-4). Seepage from the WRSF enters the sedimentation pond via the colluvium, which is hydraulically connected to the underdrain system. The pond is unlined, so some water in the pond infiltrates to groundwater (Figure 3.6-4). However, the pond will be lined in the future to prevent such infiltration (Section 2.4.1.6).

There are seven wells in the Buckskin Creek watershed to monitor groundwater associated with the Buckskin WRSF (Figure 3.6-4., Figure 3.6-5). Artesian flow in BW1 and BW3 demonstrates upward groundwater flow from deep bedrock. In wells with final depths in the colluvium, the groundwater flow is approximately horizontal, mimicking the gradient of the topography. There is a slight downward groundwater flow between the colluvium and intermediate-depth bedrock aquifers between BW2 and BW4. Downstream of the sedimentation pond, observations from BW5, BW6, and BW7 indicate equalization between the units, with a very slight upward groundwater flow above the confluence of Buckskin and Thompson creeks. These groundwater flow patterns function as a hydraulic trap that limits downgradient groundwater flow, i.e., seepage through the waste rock stays in the local, shallow aquifer that discharges to Thompson Creek and does not enter the deeper, regional aquifer. Both surface and groundwater flows through the colluvium and metasedimentary rock in the Buckskin watershed vary seasonally, as expected in a snowmelt driven system (Table 3.6-14).

Table 3.6-14. Buckskin watershed mean annual groundwater flow rates.

Geologic Unit	Hydraulic Conductivity (feet/second)	Flow Rate (gpm)
Colluvium	2.2×10^{-4}	12.7
Metasedimentary rocks	1.1×10^{-6}	1.6

A surface water gaging station is downgradient of the point where groundwater and waste rock seepage exit the Buckskin WRSF underdrain. Flow at the gaging station was divided by source into total flow and water derived from infiltration (seepage) through the facility, which is considered mine water. Spring snowmelt produces the maximum flows at this station (Table 3.6-15).

Table 3.6-15. Flow and infiltration, toe of Buckskin WRSF.

Flow Event	Flow (acre-feet/year)	Infiltration (acre-feet/year)	Percent of Flow from Infiltration (%)
Maximum	1200	910	76
Mean	520	410	79
Minimum	140	105	74

Sulfate was used as a conservative[10] tracer to determine the influence of the Buckskin WRSF on water chemistry in the analysis area based on the assumption that the only sources of sulfate in the hydrologic system within the WRSF are oxidized sulfide minerals from the waste rock. The concentration of sulfate increased from approximately 600 mg/L in early 2000 to approximately 1,050 mg/L in late 2010 at the toe of the Buckskin WRSF. The increasing concentrations indicate that sulfide oxidation occurs in the facility, but due to the excess alkalinity, there has not been ARD, and the uniform concentrations of alkalinity indicate the system is well-buffered. The dominant volcanic and metasedimentary rocks in the facility are non-acid generating. However, the rocks contain enough sulfide minerals, notably pyrite and molybdenite, to be a source of sulfate under the oxidizing conditions of the facility. The concentrations of sulfate in groundwater in the colluvium and metasedimentary rock form a sulfate plume extending 100 feet below the ground surface, with the majority of the plume in the colluvium. The plume in the bedrock metasedimentary and volcanic rocks extends from the toe of the facility to Thompson Creek. The discharge of this groundwater contributes sulfate to Thompson Creek. In addition to sulfate, the concentration of calcium in groundwater has increased from approximately 190 mg/L in 2000 to 240 mg/L in 2010, primarily via the dissolution of pH buffering minerals, principally calcium carbonate ($CaCO_3$).

[10] a conservative tracer does not react with other compounds along the flow path

South

North

Phase 7 and Phase 8
Buckskin Toe

Proposed
Cutoff
Wall

Elevation

6800
6600
6400
6200

TC3
Thompson Creek
Buck
BW7(6448)
BW5(6448)
BW6(6448)
001
Pond Dam
Buck P
Buckskin Toe
Sediment Pond
BW2(6551)
BW3(6596)
BW4(6554)
Buck C
BW1

PASSIVE ZONE
K=0.07ft/day

Groundwater Flow

ACTIVE ZONE
K=93.5ft/day

PASSIVE ZONE
K=0.09ft/day

ACTIVE ZONE
K=0.07ft/day

0+000
0+500
1+000
1+500
2+000
2+500
3+000
3+500
4+000

Waste rock
Colluvium
Volcanics
Metasediments

Underdrain
Active groundwater flow zone
Waste rock storage facility drainage* (arrow shows direction of flow)
Background groundwater*

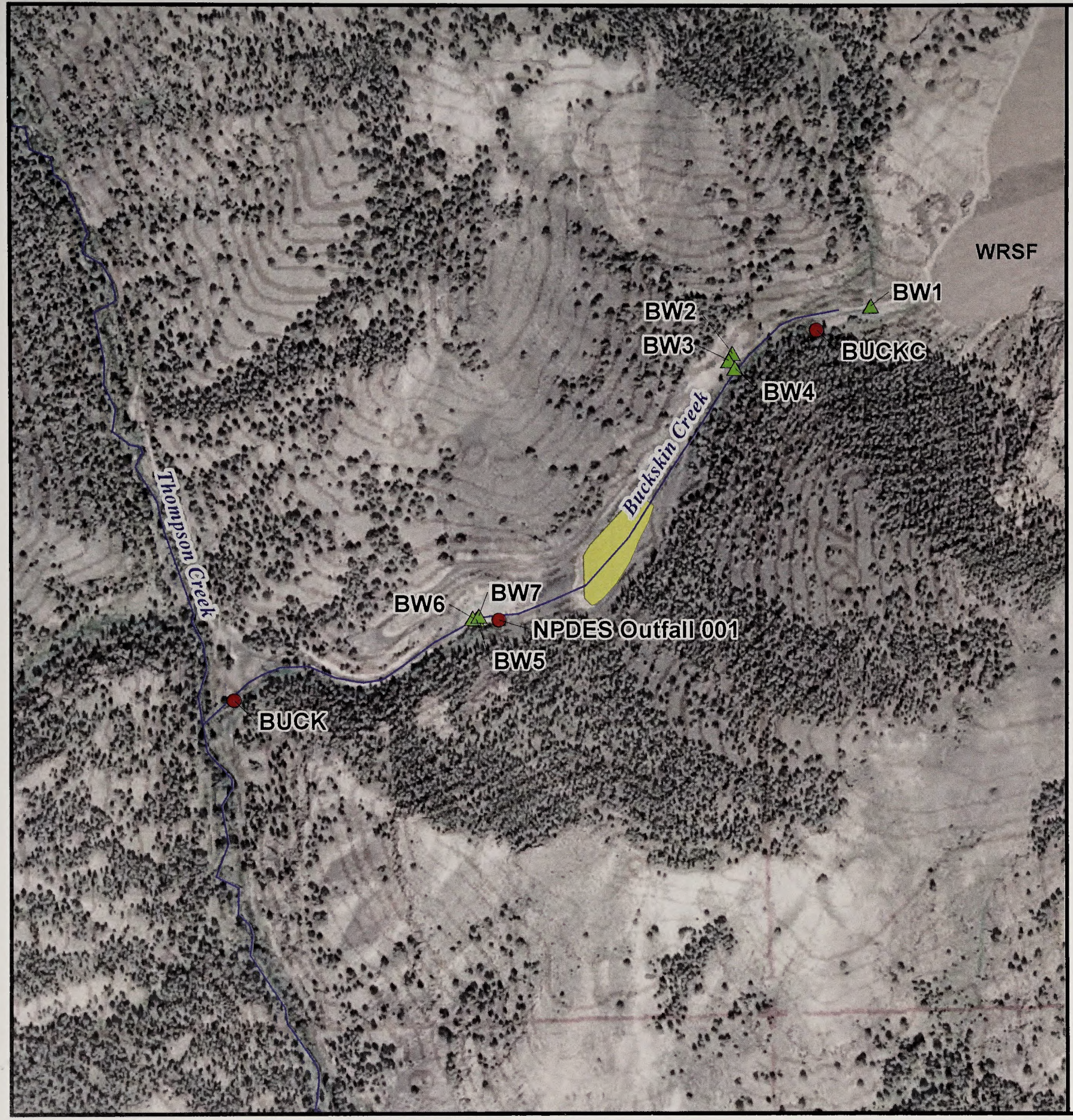
Pipeline
Monitoring well
K= 19 ft/day geomean hydraulic conductivity
* = Current conditions

Units: Feet
Vertical Exaggeration: 2X
Modified September 23, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Source: JBR (2012g)

Figure 3.6-4
Buckskin Creek drainage cross-section
Thompson Creek Mine EIS



Legend

- Monitoring well
- Surface water monitoring site
- Sedimentation pond

N

1:7,200

0 600 Feet

0 200 Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-5
Buckskin Creek drainage plan view
Thompson Creek Mine EIS

The Idaho groundwater standard (IDAPA 58.01.11) for sulfate is 250 mg/L, which is a secondary standard (based on aesthetic qualities whereas primary standards are based on protection of human health).

Concentrations of measured parameters at the Buckskin WRSF (BuckC) are generally at their lowest in spring or early summer, following snowmelt when maximum flow through the waste rock increases dilution. BuckC is the surface water monitoring station that collects seepage and groundwater from the WRSF underdrain. The highest concentrations of most constituents occur in the fall and winter when the flow volumes are at their seasonal lows, except the concentration of selenium is highest during spring melt. The two parameters of interest being leached are selenium and molybdenum, with peak total concentrations of 0.056 mg/L and 0.080 mg/L, respectively (Table 3.6-16).

Table 3.6-16. Groundwater quality, BW1, BW2, BW4, and BuckC (2009 to 2010).
all units are mg/L except s.u. for pH

	Measured					
	BW1 Deep Meta-sediments	BW2 Shallow Meta-sediments	BW4 Colluvium	BuckC		Idaho Ground-water Standard
Parameter	(Mean)	(Mean)	(Mean)	(Mean)	(Max)	
pH	8.1	7.6	7.3	8.1	8.2	6.5 – 8.5[1]
SO_4^{2-}	51.5	143	**942**	**976**	**1120**	250[1]
Al	0.002	0.003	0.002	0.0027	0.008	0.2[1]
As		.0082		0.00084	0.0016	0.05[2]
Cd	0.00002	0.00005	0.0004	0.00021	0.00041	0.005[2]
Co	0.00005	0.0001	0.0005	0.00053	0.001	
Cu	0.00005	0.0006	0.0003	0.0012	0.003	1.3[2]
Fe		< 0.03				0.3[1]
Mn	0.017	0.007	0.0002	0.0019	0.010	0.05[1]
Mo	0.020	0.047	0.048	0.063	0.078	
Ni	0.0002	0.0004	0.0019	0.0016	0.008	
Pb	0.00005	0.00005	0.00005	0.00015	0.00023	0.015[2]
Se	0.00005	0.003	0.033	0.037	0.056	0.05[2]
U	0.001	0.016	0.0098	0.010	0.012	
Zn	0.001	0.002	0.0083	0.0063	0.010	5[1]

[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho groundwater standard

The loading of constituents into Thompson Creek from groundwater exiting the Buckskin Creek watershed was estimated by multiplying groundwater flow rates in the colluvium and metasedimentary rocks (Table 3.6-14.) by the mean concentrations of constituents measured in samples of groundwater from BW4 for the colluvium and BW2 for the metasedimentary rocks (Table 3.6-16.), and converting to pounds per day and pounds per year (Table 3.6-17).

Table 3.6-17. Groundwater loading to Thompson Creek from Buckskin Creek watershed.

Parameter	Thompson Creek Background Concentration (mg/L)[1]	Buckskin[2] Basin Load (metased. rock) (pounds/day)	Buckskin Basin Load (colluvium + metased. rock) (pounds/day)	Buckskin Basin Load (colluvium + metased. rock) (pounds/year)
pH	8.1 s.u.			
SO_4	14.1	2.72	146.49	53,444
Al	0.0088	0.00006	0.00036	0.132
As	0.00051	0.00015	0.00016	0.0576
Cd	0.00005	$1.91x10^{-6}$	0.00006	0.0226
Co	0.0001	$1.91x10^{-6}$	0.00008	0.0285
Cu	0.00081	0.00002	0.00006	0.0209
Fe	0.03	0.00057	0.00057	0.209
Mn	0.00048	0.00013	0.00017	0.0603
Mo	0.002	0.00090	0.01636	5.97
Ni	0.0005	$7.62x10^{-6}$	0.00030	0.109
Pb	0.000075	$1.91x10^{-6}$	$9.53x10^{-6}$	0.0031
Se-T	0.002	0.00006	0.00509	1.86
U	0.001	0.00030	0.00180	0.658
Zn	0.003	0.00038	0.00130	0.476

[1] except as noted for pH
[2] at BW2 in shallow metasedimentary rock

Pat Hughes Creek Watershed

Unlike the Buckskin WRSF, the Pat Hughes WRSF is used primarily for the storage of Type 2 rock, as well as a smaller percentage of Type 1 rock and low grade ore. The upper Pat Hughes Creek watershed is primarily underlain by volcanic rock, which extends down the valley and pinches out below the current toe of the Pat Hughes WRSF. The volcanic rocks are underlain by the Copper Basin Formation (metasedimentary rock, hardened mudstone). The valley floor is covered with alluvium and colluvium that increases in thickness downgradient. An underdrain was constructed to promote the collection of seepage after development of the facility, and is thus not underneath the uppermost portion of the facility. Monitoring location PH Toe is the surface water quality and flow monitoring station for the WRSF. Seepage emanating from the

WRSF reports to PH Toe and includes 1) groundwater discharging to the base of the WRSF; 2) surface runoff that infiltrates the lateral margins of the WRSF; and 3) precipitation that falls onto and infiltrates into the WRSF. The seepage at PH Toe is collected and conveyed directly to the Thompson Creek pipeline. Some seepage from the Pat Hughes WRSF passes under the collection system and eventually reaches Thompson Creek, but apparently with no discernible effect on the water quality of Thompson Creek (Section 3.6.1.1.). Surface water run-off from the upper Pat Hughes drainage basin is collected and routed around the WRSF. This includes run-off from the forested watershed upgradient of the WRSF, as well as run-off from the facilities area (e.g., mine shop and crusher). This water is routed around the WRSF by a pipeline and conveyed to Pat Hughes Creek at monitoring station PAT upstream of the sedimentation pond. Water from the sedimentation pond may then be discharged to Thompson Creek via Outfall 002 if the water meets NPDES permit limits, or it may be routed to the Thompson Creek pipeline for reuse in the mill.

There are 13 wells in the Pat Hughes watershed to monitor groundwater associated with the Pat Hughes WRSF (Figure 3.6-6., Figure 3.6-7). Nested wells were installed in 1999 to monitor groundwater at three depths just downgradient of the facility (PW1, PW2, and PW3). The base of PW1 is in the deep metasedimentary bedrock aquifer, the base of PW2 is in the shallow to intermediate depth volcanic bedrock aquifer, and the base of PW3 is in the colluvium aquifer (Figure 3.6-6). The wells were decommissioned in October 2009 prior to being buried by the planned expansion of the Pat Hughes WRSF; at the time of decommissioning, only the shallow, colluvium well (PW3) showed water quality effects from the WRSF. Well PW4 was installed with its base at the waste rock/colluvium interface in 2005 to monitor water within the WRSF. Water levels in PW4 vary with spring run-off, indicating unsaturated and free-draining flow within the facility.

Similar to the Buckskin watershed, most of the Pat Hughes watershed is covered by a thin layer of colluvium. The colluvium is underlain by a zone of fractured bedrock that transitions into more competent rock with depth. The groundwater flow in the upper areas of the watershed, where water flows through the colluvium and intermediate and shallow bedrock, is approximately horizontal and mimics the gradient (~ 10 %) of the topography. The Pat Hughes sedimentation pond (Figure 3.6-7.) may be a source of groundwater recharge. Near the toe of the Pat Hughes WRSF, seepage from the waste rock travels in the shallow colluvium aquifer, which is indicated by concentrations of sulfate of approximately 1,000 mg/L measured in samples from PW3 in the colluvium. The concentrations of sulfate samples from PW1 and PW2 indicate the colluvium groundwater is not hydraulically connected with the underlying intermediate and deep bedrock aquifers. Historic water levels indicate there is an upward hydraulic gradient (~ 5 %) between the deeper (PW1) and intermediate (PW2) bedrock aquifers (Figure 3.6-6).

Farther downgradient towards Thompson Creek, the volcanic bedrock pinches out leaving the metasedimentary bedrock closer to the surface (Figure 3.6-6). Groundwater in the intermediate bedrock is mixing with shallower groundwater in the colluvium, as inferred from the relatively high concentrations of sulfate in samples from PW7, PW8, and from surface water in Pat Hughes Creek (PAT). Mixing of the shallow and intermediate groundwater appears to be enabled by high permeability zones in the bedrock. The concentrations of sulfate become increasingly lower (diluted) downgradient of PH Toe, due in part to the collection of seepage

from the toe for use in the mill, and also presumably due to dilution by lateral inflow of groundwater from the steep valley walls at the sides of the Pat Hughes watershed which has not contacted waste rock. There is also a distinct downward flow of groundwater (10 % gradient) between the colluvium and the intermediate bedrock aquifer (PW15 and PW14) and a distinct upward flow of groundwater (13 % gradient) between the deep and intermediate bedrock aquifers (PW13 and PW14). The shallow colluvium aquifer does not appear to be as hydraulically connected to the deep bedrock aquifer as is the intermediate aquifer.

The deep aquifer is less permeable and has lower concentrations of sulfate suggesting that it has not been influenced by seepage from the WRSF (PW13 and PW10). Groundwater flow rates have been estimated for the colluvium, metasedimentary rock, and volcanic rock (Table 3.6-18).

Table 3.6-18. Pat Hughes Creek watershed mean annual groundwater flow rates.

Geologic Unit	Hydraulic Conductivity (feet/second)	Flow Rate (gpm)
Colluvium	2.2×10^{-4}	20.6
Metasedimentary rock	3.9×10^{-6}	11.1
Volcanic rock	8.24×10^{-7}	nc

Measured through the cross-section at PW10, PW11, and PW12.
nc = value has not been calculated

Annual and monthly flow volumes were monitored at the PH Toe monitoring station (Figure 3.6-7., Table 3.6-19). The percentage of flow from infiltration from the Pat Hughes WRSF is only about half that from infiltration in the Buckskin WRSF because the overall area of the Pat Hughes watershed is larger and the Pat Hughes facility occupies a much smaller percentage of its watershed than the Buckskin facility occupies of its watershed.

Table 3.6-19. Flow and infiltration, toe of Pat Hughes WRSF.

Flow Event	Flow (acre-feet/year)	Infiltration (acre-feet/year)	Percent of Flow from Infiltration
Maximum	1100	462	42
Mean	390	183	47
Minimum	130	56	43

South

North

Elevation

6600
6400
6200
6000
5800

Thompson Creek Mine Pipeline
Thompson Creek
Pat Hughes Pipeline
TC1
Phase 8 Sediment Pond Dam
Phase 8 Pat Hughes Sediment Pond
PW12(6067)
PW10(6062)
PW11(6066)
Proposed Phase 8 Cutoff Wall
PW15(6141)
PW13(6160)
PW14(6134)
002
PATP
Extent of Pat Hughes Phase 8 Toe
Phase 7 Pat Hughes Sediment Pond
PW8(6250)
PW7(6247)
PAT
Proposed Phase 7 Cutoff Wall
Extent of Pat Hughes Phase 7 Toe
PW3
PW1
PW2
PHTOE
Existing 2010 Pat Hughes Toe

ACTIVE ZONE K=19ft/day
ACTIVE ZONE
ACTIVE ZONE K=80ft/day
ACTIVE ZONE K=19ft/day
ACTIVE ZONE
ACTIVE ZONE
PASSIVE ZONE K=0.07ft/day
PASSIVE ZONE K=0.13 ft/day
Groundwater Flow
Groundwater Flow

0+000 0+500 1+000 1+500 2+000 2+500 3+000 3+500 4+000 4+500 5+000 5+500

Waste rock
Colluvium
Volcanics
Metasediments

Underdrain
Active groundwater flow zone
Waste rock storage facility drainage* (arrow shows direction of flow)
Background groundwater*

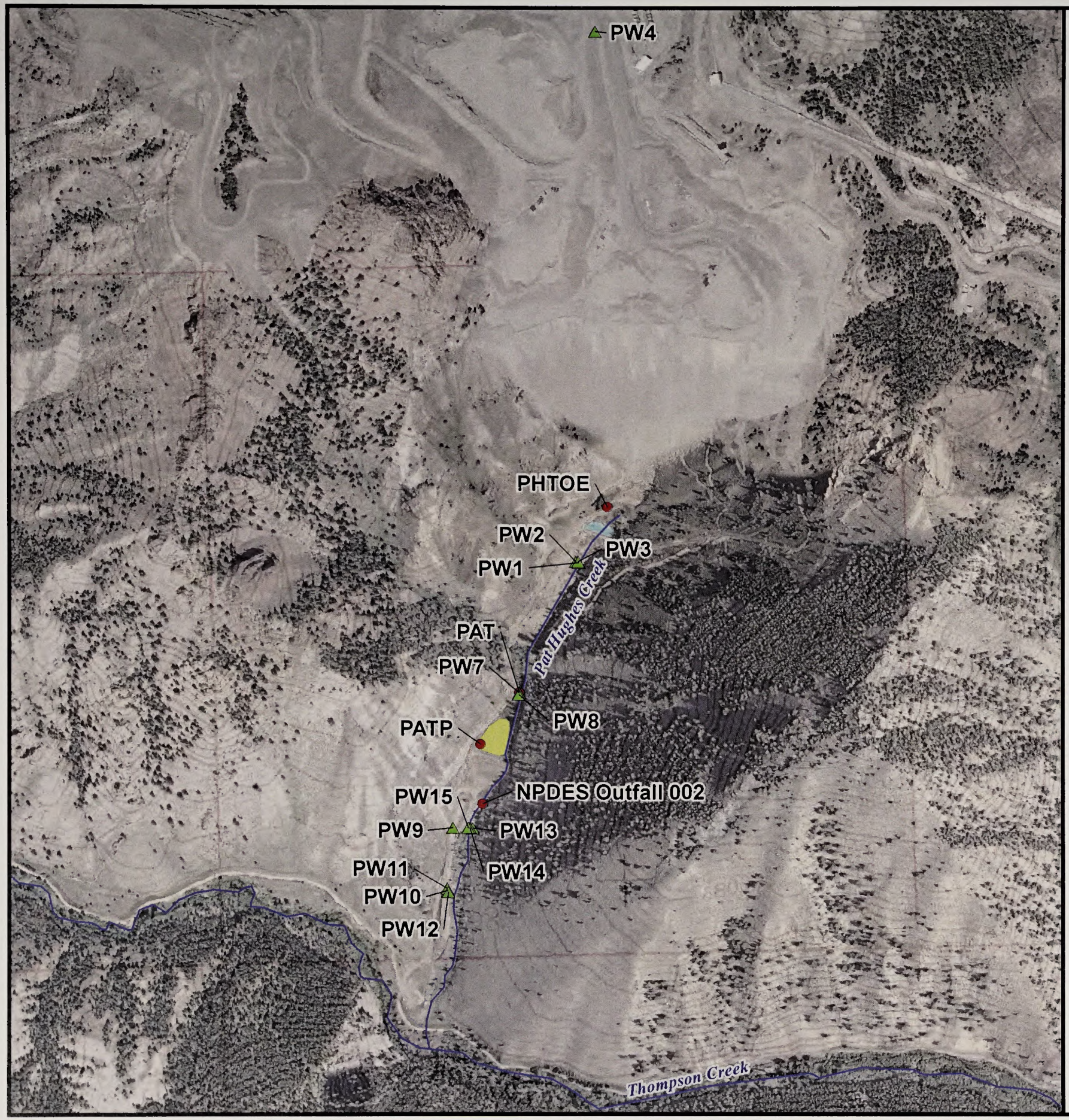
Pipeline
Monitoring well
K= 19 ft/day geomean hydraulic conductivity
* = Current conditions

Units: Feet
Vertical Exaggeration: 1X
Modified September 23, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Source: JBR (2012g)

Figure 3.6-6
Pat Hughes Creek drainage cross-section
Thompson Creek Mine EIS



Legend

- Monitoring well
- Surface water monitoring site
- Sedimentation pond

N

1:14,000

0 1,200 Feet

0 400 Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-7
Pat Hughes Creek drainage plan view
Thompson Creek Mine EIS

Prior to spring snowmelt in 2003, the water quality of seepage from waste rock in the Pat Hughes facility was good, i.e., low concentrations of metals and near neutral pH. However, during spring snowmelt the chemistry of the water changed abruptly. The seasonal increase in flow from the facility had a distinct decrease in pH to approximately pH 4.5 with a corresponding increase in the concentrations of dissolved metals. For example, the concentration of zinc increased from approximately 200 µg/L to more than 5,000 µg/L. As peak flows subsided, the pH returned to near neutral (i.e., ~ pH 7), and the concentrations of metals decreased to the concentrations prior to spring melt.

Another change in geochemical pattern occurred in 2004. Following peak run-off, the pH of seepage water from the Pat Hughes WRSF did not immediately return to near neutral (remained < pH 6.0). The pH began to increase in 2005 following a relatively dry year reaching near neutral values (pH 6.5) immediately before spring snowmelt in 2006, which had the highest flow (1,300 gpm) measured during the study period (late 1999 to 2010). Since spring snowmelt in 2006, the pH has remained low and relatively stable (pH 4.2 to pH 4.9) with a median value of pH 4.6. The year 2003 is considered to be the onset of perennial ARD conditions from the Pat Hughes WRSF, i.e., the buffering capacity of waste rock in the Pat Hughes WRSF was exceeded by the acid-generating capacity of the Type 2 waste rock.

Metal loadings from the facility increased seasonally from 2002 to 2004 and increased perennially beginning in 2006, during which the highest monthly loads of sulfate were measured to date (2010). (A *load* is the concentration of a contaminant multiplied by the flow rate. The load of a given contaminant therefore provides more comparative information for assessing or comparing effects than a concentration does.) As flow conditions returned to normal later in 2006, the increased loads of metals persisted and the pH remained relatively low (< pH 5.0). The increased loads of metals in 2006 were probably due to compounding factors, including a lower-than-average spring run-off the year prior (less flushing within the Pat Hughes WRSF) and the build-up of oxidation products. During subsequent years there have been gradual increases in peak concentrations of metals during spring snowmelt with no obvious correlation to changes in peak flow volumes or pH (Table 3.6-20., Table 3.6-21).

Mine-affected water entering Thompson Creek from the Pat Hughes watershed predominantly occurs via groundwater, the exception being when controlled releases occur out NPDES Outfall 001. These releases are infrequent and occur only when the NPDES permit water quality standards are met. The loading of metals and other constituents to Thompson Creek via the groundwater flowpath was estimated by multiplying groundwater flow rates by groundwater concentrations. Groundwater flow rates were estimated from measured gradients, hydraulic conductivity, and cross-sectional areas for flowpaths within the colluvium and metasedimentary bedrock (Table 3.6-18). Groundwater concentrations were based on mean values measured in wells screened within colluvium (PW11) and metasedimentary bedrock (PW12) downgradient of the sedimentation pond (Table 3.6-22). Current (2010) loadings to Thompson Creek are summarized in pounds per day and pounds per year and are compared to background water quality in Thompson Creek in Table 3.6-23.

Table 3.6-20. Groundwater quality, Pat Hughes Crk. watershed, spring melt (March 2010).

	Elev./Depth	pH	NO_3^-/ NO_2^-	SO_4	Al	As	Cd	Cu	Fe	Pb	Mn	Mo	Ni	Se	Zn
Station	**Feet**	**s.u.**	**mg/L**	**mg/L**	**mg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
NW2	Shallow	7.3	0.54	13	0.002	0.3	0.06	0.4	15	0.11	0.07	0.81	0.05	0.5	1
PH Toe	6430	4.88	9.8	956	14.5	1.1	18.7	104	15	0.79	9660	4.34	31.8	19	1370
PAT	6268	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PATP	6240	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW1	Deep	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW2	Medium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW3	Shallow	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW4	Shallow	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW7	Medium	7.4	1.04	**307**	0.003	0.5	0.01	2.7	15	0.025	7.01	5.15	3.1	4	28
PW8	Shallow	6.84	0.66	189	0.002	0.2	0.04	0.05	15	0.025	20.1	13.9	0.2	2	2
PW9	Shallow	7.07	0.89	**277**	0.002	0.7	0.03	0.05	15	0.025	1.33	17.8	1.1	4	3
PW10	Deep	7.27	0.02	138	0.002	1.2	0.05	0.25	142	0.025	162	5.05	4	2	179
PW11	Medium	7.37	0.005	248	0.0025	9.1	0.01	0.05	15	0.025	248	6.19	3.1	0.5	26
PW12	Shallow	7.4	0.7	248	0.002	0.4	0.04	0.05	15	0.025	1.7	14	0.05	3	1
PW13	Deep	7.45	0.005	182	0.003	0.4	0.01	0.2	137	0.025	278	1.88	1	0.5	160
PW14	Medium	7.57	0.005	**293**	0.002	2.3	0.01	2.3	62	0.025	312	8.51	3.9	2	8
PW15	Shallow	7.02	0.49	235	0.003	0.2	0.05	0.2	15	0.025	18.3	8.55	2.5	2	2
Idaho Standard =		6.5-8.5[1]	10[2]	250[1]	200[1]	50[2]	5[2]	1,300[2]	300[1]	15[2]	50[1]			50[2]	5,000[1]

ND = no data

[1] secondary standard, IDAPA 58.01.11

[2] primary standard, IDAPA 58.01.11

bold typeface indicates exceeds Idaho groundwater standard

Table 3.6-21. Groundwater quality, Pat Hughes Crk. watershed, base flow (August 2010).

	Elev./Depth	pH	NO_3^-/NO_2^-	SO_4	Al	As	Cd	Cu	Fe	Pb	Mn	Mo	Ni	Se	Zn
Station	Feet	s.u.	mg/L	mg/L	mg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
PH Toe	6430	**4.7**	5.14	**958**	11.6	0.7	13.7	76.4	15	1.65	7480	3.11	28.4	11	1150
PAT	6268	8.21	0.52	132	0.005	0.5	0.01	0.4	15	0.025	0.025	8.42	0.2	1	1
PATP	6240	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW1	Deep	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW2	Medium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW3	Shallow	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PW4	Shallow	**5.91**	1.97	159	0.013	0.05	0.78	0.2	15	0.025	110	43.6	0.8	0.5	51
PW7	Medium	7.07	0.8	**285**	0.001	0.5	0.01	0.05	15	0.025	2.33	5.05	0.05	3	8
PW8	Shallow	6.55	0.26	121	0.0005	0.4	0.01	0.05	15	0.025	0.97	10.5	0.05	1	1
PW9	Shallow	6.97	0.98	185	0.001	0.4	0.03	0.1	15	0.025	0.21	18.2	0.05	3	1
PW10	Deep	7.06	0.16	147	0.0005	2.7	0.02	0.25	1040	0.025	69.3	1.78	0.4	0.5	8
PW11	Medium	7.06	0.01	249	0.1	8.4	0.03	0.3	203	0.33	206	3.66	2.1	0.5	18
PW12	Shallow	6.84	0.78	214	0.0005	0.4	0.03	0.05	15	0.025	0.18	14.7	0.05	3	1
PW13	Deep	7.24	0.005	172	0.001	0.2	0.01	0.05	422	0.025	206	1.55	0.3	0.5	1
PW14	Medium	7.41	0.005	**301**	0.002	3.3	0.01	0.8	450	0.025	276	7.19	0.05	0.5	1
PW15	Shallow	6.85	0.65	204	0.001	0.4	0.03	0.2	15	0.025	0.42	17.6	0.5	3	1
Idaho standard		6.5-8.5[1]	10[2]	250[1]	0.2[1]	0.05[2]	5[2]	1,300[2]	300[1]	15[2]	50[1]			50[2]	5,000[1]

ND = no data
[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho groundwater standard

Table 3.6-22. Mean water quality, PW11 and PW12 (2010).
all units are mg/L except s.u. for pH

Parameter	PW11 (colluvium)	PW12 (metasedimentary rock)	Idaho Groundwater Standard
pH	7.63	7.32	6.5-8.5[1]
Al	0.027	0.001	0.2[1]
As	0.008	0.0004	0.05[2]
Cd	0.000035	0.00004	0.005[2]
Co	0.00115	0.0002	
Cu	0.00015	0.0001	1.3[2]
Fe	0.106	0.030	0.3[1]
Mn	**0.166**	0.002	0.05[1]
Mo	0.006	0.015	
Ni	0.002	0.0002	
Pb	0.00012	0.00005	0.015[2]
Se	0.001	0.003	0.05[2]
SO_4	245	221	250[1]
U	0.0085	0.003	
Zn	0.022	0.002	5[1]
Acidity	-	-	

[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho groundwater standard

Table 3.6-23. Groundwater loading to Thompson Creek from Pat Hughes Creek watershed (2010).

Parameter	Thompson Creek Background (mg/L)[1]	Pat Hughes (metasediment rock) (pounds/day)	Pat Hughes (colluvium + metasediment rock (pounds/day)	Pat Hughes (colluvium + metasediment rock (pounds/year)
pH	8.1 s.u.			
SO_4^{2-}	14.1	29.47	87.63	32,887
Al	0.0088	0.00013	< 0.00095	2.51
As	0.00051	0.00005	0.00133	0.74
Cd	0.00005	0.00001	< 0.00001	0.005
Co	0.0001	0.00003	0.00019	0.114
Cu	0.00081	0.00001	< 0.00019	0.018
Fe	0.03	0.00400	< 0.01143	11.1
Mn	0.00048	0.00027	0.03810	15.1
Mo	0.002	0.02000	0.00381	1.27
Ni	0.0005	0.00003	0.00038	0.19
Pb	0.000075	6.67×10^{-6}	< 0.00008	0.013
Se-Total	0.002	0.00040	< 0.00076	0.24
U	0.001	0.00040	0.00191	0.913
Zn	0.003	0.00027	0.00381	2.11

[1] except as noted for pH

No Name Creek Watershed

The No Name Creek watershed (intermittent flow) does not contain any mine facilities. The valley floor is composed of colluvium and alluvium up to 35 feet thick. Exposed bedrock consists of the volcanic rock throughout the watershed, which was measured as 600 feet thick adjacent to the pit and 900 feet thick near the confluence of No Name and Thompson creeks (Figure 3.6-8). There are two monitoring wells in the watershed: NW1 in colluvium to a depth of 35 feet below the ground surface, and NW2 in shallow volcanic bedrock to a depth of 60 feet below the ground surface (Figure 3.6-8., Figure 3.6-9). The wells indicate downward groundwater flow at the well sites. The lower reaches of the watershed are a groundwater discharge zone, indicated by natural springs that infiltrate back into the colluvium a short distance away. Two water samples from NW2 were analyzed in 2010. Both samples had neutral pH and low concentrations of most constituents, including sulfate and TDS (Table 3.6-24).

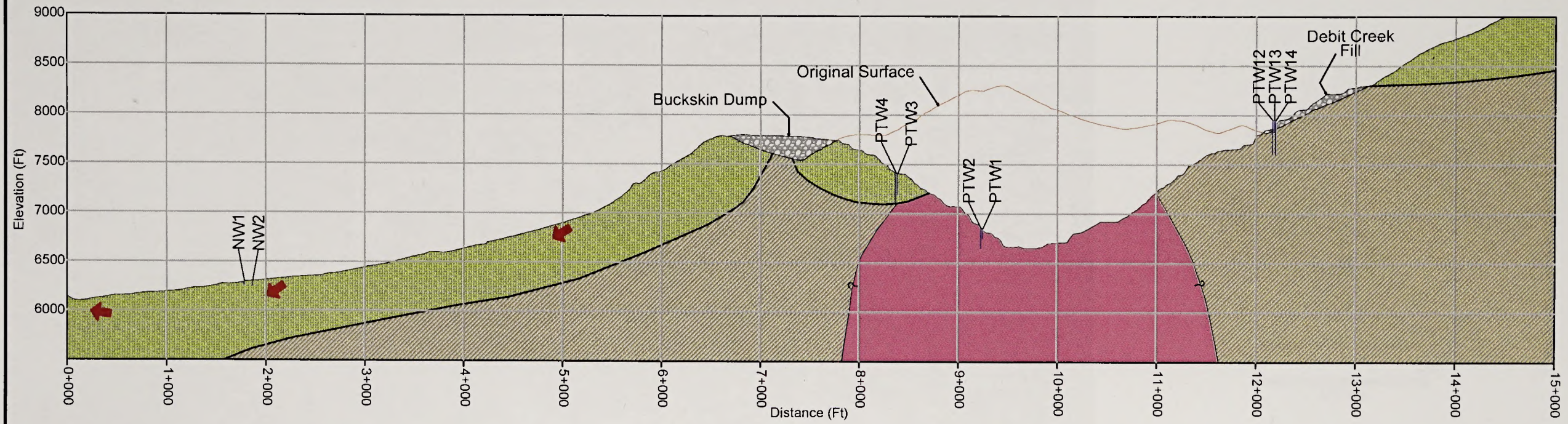
Table 3.6-24. Groundwater quality, No Name Creek watershed.

Parameter	Unit	NW2			Idaho Groundwater Standard
		3/28/2010	8/20/2010	Mean	
pH	s.u.	7.12	6.9	7.0	6.5-8.5[1]
Alkalinity	mg/L	106	108	107	
Hardness	mg/L	96	102	99	
TSS	mg/L	169	29	99	
TDS	mg/L	142	140	141	500[1]
NO_2^-/NO_3^-	mg/L	0.54	0.29	0.42	10[2]
SO_4^{2-}	mg/L	13	10	12	250[1]
Cl^-	mg/L	0.8	0.8	0.8	250[1]
DOC	mg/L	0.5	0.7	0.6	
S^{-2}	mg/L	< 0.04	< 0.04	< 0.04	
DISSOLVED METALS					
Ca	mg/L	32	35	33.5	
Mg	mg/L	4	4	4	
K	mg/L	< 1	< 1	< 1	
Na	mg/L	12	13	12.5	
Al	µg/L	2	< 1	1.5	200[1]
Sb	µg/L	< 0.05	< 0.05	< 0.05	6[2]
As	µg/L	0.3	0.4	0.4	50[2]
Be	µg/L	< 1	< 1	< 1	4[2]
Cd	µg/L	0.06	0.03	0.05	5[2]
Cu	µg/L	0.4	< 0.1	0.25	1,300[2]
Cr (Total)	µg/L	< 0.5	< 0.5	< 0.5	100[2]
Fe	µg/L	< 30	< 30	< 30	300[1]
Pb	µg/L	0.11	< 0.05	0.08	15[2]
Mn	µg/L	0.07	0.59	0.33	50[1]
Hg	µg/L	< 0.05	< 0.05	< 0.05	2[2]
Mo	µg/L	0.81	0.42	0.62	
Ni	µg/L	< 0.1	< 0.1	< 0.1	
Se	µg/L	< 1	< 1	< 1	50[2]
Ag	µg/L	< 0.03	< 0.03	< 0.03	
Ti	µg/L	< 0.5	< 0.5	< 0.5	
Zn	µg/L	< 2	< 2	< 2	5,000[1]

[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11

South

North



- Waste rock
- Qal - Colluvium
- Tcb - Volcanics
- Mcb - Metasediments
- Kgrd - Intrusive
- Monitoring well
- Direction of flow

Units: Feet
Vertical Exaggeration: 1X
Modified September 23, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Source: JBR (2012g)

Figure 3.6-8
No Name Creek drainage cross-section
Thompson Creek Mine EIS



Legend

▲ Monitoring well

N

1:7,200

0 600

Feet

0 200

Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM

Figure 3.6-9
No Name Creek drainage plan view
Thompson Creek Mine EIS

(discussed below). Despite substantial scatter in the data, it appears the concentrations of sulfate have increased at MW1 since June 1993 and at MW2 since October 2007.

The deep bedrock well BC3 encountered extensive fractures from approximately 250 feet below the ground surface to the bottom of the well. Interpretation of the pump test results suggest that these fractures provide moderate to high secondary permeability. Artesian conditions have been observed at BC3 and BC3A since their installation. The concentrations of sulfate in samples of water from BC3 (median value of 61 mg/L) and BC3A (median value of 51 mg/L) are similar to such concentrations in samples of water from background sites, indicating that the TSF has not affected the quality of groundwater at this location. The lower Bruno Creek drainage is characterized as a groundwater discharge zone.

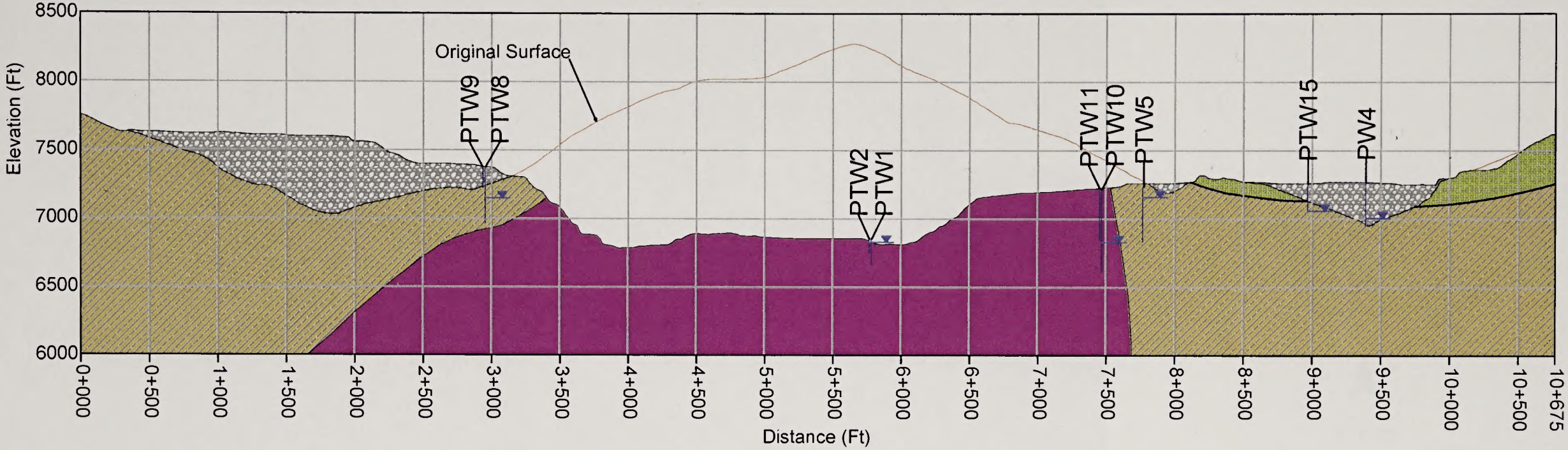
The TSF was designed to have no releases to surface waters. However, there are small amounts of seepage from TSF into the underlying groundwater, and the 1980 EIS indicated this would cause the water quality of Bruno Creek to exceed EPA criteria at times (USFS 1980, p. 5-10). The seepage reaches Redbird Creek via the paleo (ancient)-alluvial deposits underlying the volcanic rock that forms the divide between the Bruno Creek and Redbird Creek watersheds (Figure 3.6-14). The seepage rate (estimated to be approximately 35 gpm) is inferred from concentrations of chloride and sulfate in the TSF and at surface water site RB1. The concentrations of sulfate in Redbird Creek have increased by a factor of approximately three to near 200 mg/L over the previous 10 years or more. The data are sporadic prior to 2000, but elevated concentrations of chloride and sulfate appear to have begun in 1999 to 2000.

Water in the TSF is collected in the underdrain system and passes through the base of the embankment via the main drain, which captures flow from several components. Flow in the drain fluctuates seasonally in response to cyclone operations, snowmelt, and precipitation. Peak flows generally correspond to spring run-off and summer operation of the cyclones. Low flows generally occur during winter, and average annual flow into the main drain is of the order of 1,100 gpm. The water from the main drain is collected in the SRD and pumped back to the mill for reuse. Seepage from the SRD is collected in a constructed sump and is pumped back to the SRD pond. This pumpback system functions as secondary containment of discharge from the TSF.

The TSF leaks small amounts of water into the underlying shallow groundwater with minor effects on water quality. The 1980 EIS predicted that this seepage could result in increased concentrations of iron, manganese, and zinc in the groundwater (USFS 1980, p. 5-11). The quality of groundwater downstream of the TSF has remained similar over time. However, samples from the shallow wells (MW1, MW2) have higher concentrations of sulfate and lower concentrations of dissolved iron and manganese than samples from the deeper wells (BC3, BC3A). Despite substantial scatter in the data over time (beginning in 1993), concentrations of sulfate have been increasing at MW1 since 1993 and at MW2 since 2007, suggesting that some TSF water is getting past the SRD and pump-back sump.

North

South



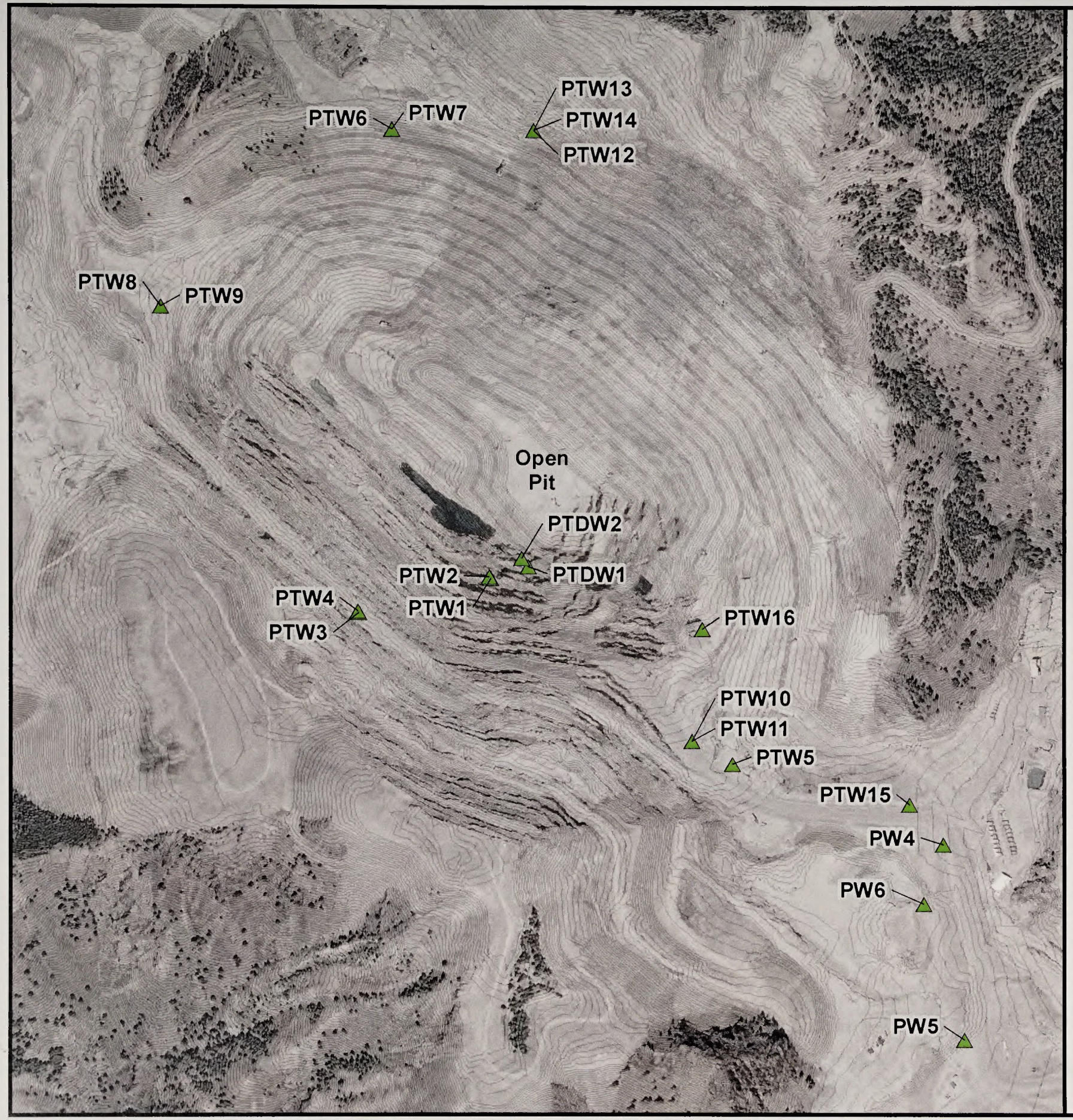
Waste rock
Colluvium
Volcanics
Metasediments
Intrusive
Monitoring well
Water level

Units: Feet
Vertical Exaggeration: 1X
Modified September 23, 2012

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Source: JBR (2012g)

Figure 3.6-10
Open Pit cross-section
Thompson Creek Mine EIS



Legend

▲ Monitoring well

N

1:12,000

0 1,000 Feet

0 300 Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-11
Open pit plan view
Thompson Creek Mine EIS

South

North

Elevation

7500
7000
6500
6000
5500
5000

S. Creek
SQ2
003
BC1
BC3 (6243)
BC3A (6243)
Twin Apex
MW2 (6499)
MW1 (6746)
Seepage Return Dam
SRD
Seepage Return Pond
MD
Rock Toe Dam

0+000 1+000 2+000 3+000 4+000 5+000 6+000 7+000 8+000 9+000 10+000 11+000 12+000 13+000 14+000 15+000 16+000 17+000 18+000 19+000

Tailings impoundment
Colluvium
Volcanics
Metasediments
Carbonates
Surface station
Monitoring well
Direction of flow

Units: Feet
Vertical Exaggeration: 2X
Modified September 23, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Source: JBR (2012g)

Figure 3.6-12
Lower Bruno Creek drainage cross-section
Thompson Creek Mine EIS



Legend

- Monitoring well
- Surface water monitoring site

N

1:30,000

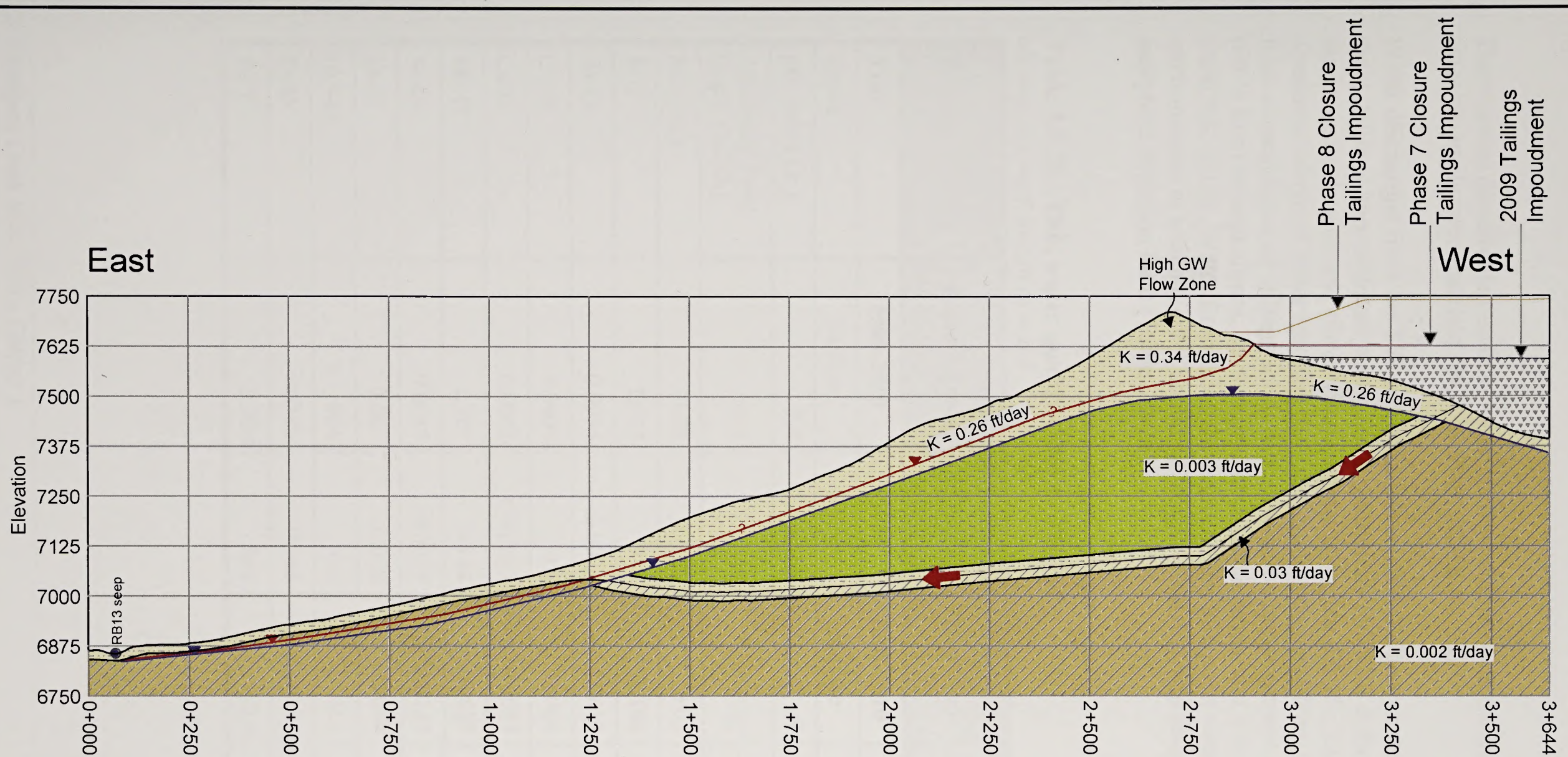
0 2,500 Feet

0 1,000 Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-13
Bruno Creek drainage plan view
Thompson Creek Mine EIS



Tailings impoundment
Volcanics
Metasediments
Active GW flow zone

Surface station
Observed water level pre-mining (SRK 1980)
Estimated maximum water level (operational)
Seepage

Units: Feet
Vertical Exaggeration: 1X
Modified September 23, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Source: JBR (2012g)

Figure 3.6-14
Flowpath from TSF to Redbird Creek drainage
Thompson Creek Mine EIS

There are no discernible trends in water quality parameters in the deeper wells (BC3 and BC3A) since the wells were installed (BC3 in 1980, BC3A in 1999).

Water discharged from the TSF has been represented and analyzed using samples from the main drain, tailings impoundment water, and a piezometer (MW10) at the interface of the tailings sands (embankment) and slimes (impoundment) (Figure 3.6-15., Table 3.6-25). Currently, the dominant source of water reaching the main drain is drainage from the impoundment, resulting from consolidation of tailings solids deposited in the impoundment (slimes) and process water (60 % from tailings slimes, 35 % from embankment sands, and 5 % from groundwater) (ANDEK 2011). Water from the main drain and the TSF pond water are both pH neutral environments in which there is abundant oxygen available, and dissolved iron was below the analytical detection limit (Table 3.6-25).

Table 3.6-25. TSF, water quality (2009 to 2010).
all units are mg/L except as noted

Parameter	Tailings Pond	MW10	Main Drain	Idaho Groundwater Standard
Year	**2009-2010**	**2010**	**2009-2010**	
Depth	Surface	39 feet	Surface	
pH, field (s.u.)	7.4	7.6	7	6.5-8.5[1]
Alkalinity-Total (mg/L $CaCO_3$)	34.5	45	122	
NO_2^-/NO_3^-	1.02	< 0.01	0.03	10[2]
SO_4^{2-}	**1,073**	**913**	**1,190**	250[1]
As-D	0.0014	0.0023	0.0019	0.05[2]
Cd-D	0.0004	0.0	0.0004	0.005[2]
Cu-D	0.0002	< 0.0001	0.0033	1.3[2]
Mo-D	1.321	0.144	0.657	
Ni-D	0.0055	0.0019	0.0124	
Zn-D	0.003	0.008	0.014	5[1]
H_2S-D	NA	0.0	NA	
Fe-D	< 0.03	0.166	< 0.03	
Fe-T	0.266	NA	**12.6**	0.3[1]

Parameter	Tailings Pond	MW10	Main Drain	Idaho Groundwater Standard
Mn-D	0.549	0.442	4.490	
Mn-T	**0.542**	NA	**4.880**	0.05[1]

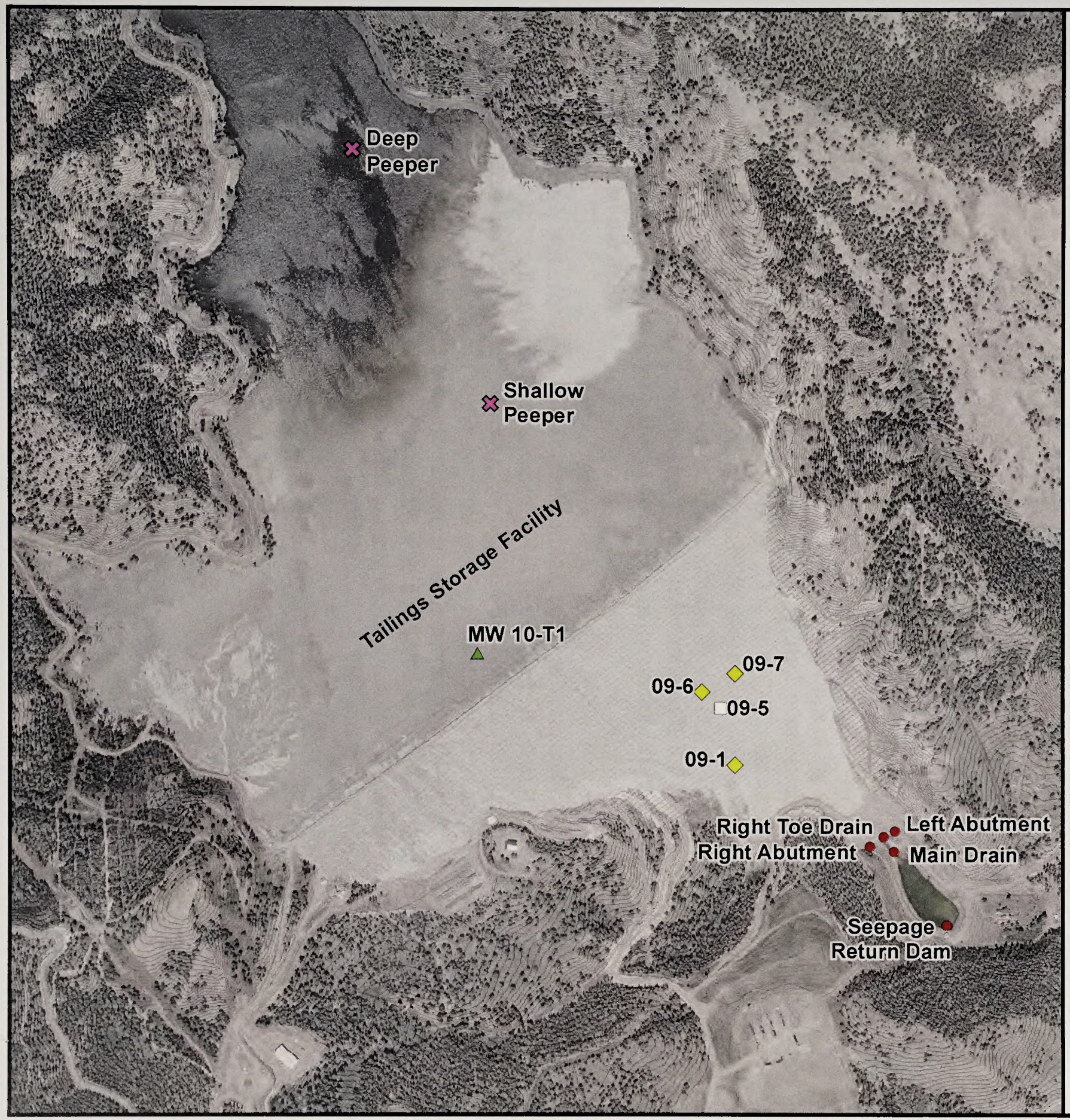
The parameters for the TSF and main drain are median values for samples collected in 2009 and 2010.
Only one sample was collected from MW10 in 2010.
NA = Not Analyzed
[1] secondary standard, IDAPA 58.01.11
[2] primary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho groundwater standard

During mining and milling operations acidity released from the embankment sands, if any, is insufficient to overcome the alkalinity from impoundment slimes drainage. Furthermore, although the concentration of dissolved iron is relatively low (< 0.03 mg/L) in the oxidizing environments of tailings pond water and the main drain (Table 3.6-25.), the concentration of total iron is relatively high (~ 12.6 mg/L in the main drain) and the concentrations of dissolved arsenic and cadmium are relatively low (< 0.0019 mg/L and < 0.0004 mg/L, respectively, in the main drain), presumably due to sorption (where one substance becomes attached to another) of arsenic and cadmium onto precipitated iron oxides. The opposite conditions are generally found in anoxic, reducing environments (e.g., MW10), where the concentrations of total arsenic and cadmium increase with depth below sediment-water interface. The concentration of sulfate is higher in the oxidizing environments and lower at MW10.

There has been an increase in the concentrations of sulfate in the colluvial aquifer below the TSF, as indicated by samples from MW2, described above. Increased concentrations of sulfate (10 mg/L background to 182 mg/L) and chloride (5 mg/L background to 38 mg/L) to S. Creek are inferred to be from Redbird Creek, but no increased concentrations of other constituents of potential concern have been found to date in S. Creek. The source of these effects is seepage from the TSF as well as seepage from the abandoned Twin Apex mine in Bruno Creek, which is not affected by the mine. Seepage from the TSF affects S. Creek via two groundwater flowpaths that report to Redbird Creek and Bruno Creek. Seepage reporting to Redbird Creek is from the impoundment, while seepage reporting to Bruno Creek is due to small amounts of main drain seepage that bypasses the pumpback system.

Groundwater Rights

TCMC owns several water rights for groundwater with allowable beneficial uses of domestic (for employee uses) and industrial. Several of the water rights are for wells that were developed within the TCMC facility area. Two of the water rights (72-7414 and 72-7573) are for groundwater that seeps into the open pit. TCMC has also applied to the IDWR for a new water right (72-16728, pending) for the increased interception of groundwater during the pit expansion that would occur under the MMPO alternatives. The majority of the monitoring wells discussed above are not associated with a consumptive use, and consequently TCMC does not have or need water rights for these types of wells. TCMC has water rights (72-7219 and 72-7220) for two potable wells at the mine for employee use.



Legend

- Peeper sites
- Piezometer
- Piezometer and borehole
- Surface water monitoring site
- Monitoring well

N

1:12,000

0 1,000 Feet

0 300 Meters

Data source JBR (2012g)
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.6-15
TSF, water quality monitoring locations
Thompson Creek Mine EIS

There are also water rights owned by others for groundwater from wells (domestic and irrigation beneficial uses) near the mouths of Thompson and S. creeks as well as along the Salmon River.

3.6.1.3. Springs

Naturally occurring springs (seeps)[11] are surface expressions of groundwater, i.e., points where the water table intercepts the ground surface. There are a number of springs in the analysis area. For example, according to water right records (IDWR 2012) the BLM has water rights for stockwatering for a number of springs along Thompson Creek. The source of some of these springs may be local alluvial deposits through which the base of Thompson Creek flows. Other potential sources might be re-emergence of water from Thompson Creek that has infiltrated into either alluvial deposits or fractured bedrock along the channel, or water from bedrock to the north. The springs along Thompson Creek are typically small (e.g., < 2 gpm, based upon discharge measurements made in 2008 by the BLM).

Several other springs discharge in the various watersheds that are tributaries to Thompson and Bruno creeks. The source of some of these springs might be small aquifers that are isolated from each other spatially due to hydraulic barriers. Two springs near the mouth of Buckskin Creek are used by TCMC under a water right that includes other nearby sources as well. An apparent natural spring (ID #BS Hillside Seep) from a hillside further upstream and to the west of the main channel supports several small wetlands (Figure 3.9-1).

No Name Creek gains in flow downgradient due to several springs along the creek (JBR 2014h). Springs occur particularly in the lower drainage where bedrock outcrops in the valley floor (SRK 1998). Water rights records include a BLM filing on a single spring near the mouth of the creek (IDWR 2012). These records also include BLM water rights for stockwatering from two springs in the Pat Hughes watershed, in or adjacent to the MMPO area. Two springs (PHSeep and PH2) in upper Pat Hughes Creek have a groundwater source (JBR 2014h). The BLM also owns water rights for stockwatering from two springs in the unnamed watersheds to the east, downgradient of the mill.

The Bruno Creek watershed contains several springs, both upstream and downstream of the TSF. There are two BLM water rights for two springs in the middle portion of the Bruno Creek watershed, near the Twin Apex property. Springs also discharge from limestone fractures in lower Bruno Creek. In addition to natural springs, there are a number of areas where seepage from the colluvium and/or bedrock into stream channels occurs as a result of the mine. These areas include Pat Hughes and Buckskin creeks, where infiltration of precipitation or run-off into or underneath the WRSFs essentially forms gaining channel reaches. Similarly, seepage from the TSF is inferred to have entered Bruno Creek below the TSF and to have also entered Redbird Creek.

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[11] Springs typically emerge from a single point, whereas seeps emerge over a larger area with no well-defined origin, typically have lower flow than springs, and rarely have enough flow to form a stream. *Spring* herein refers to both springs and seeps.

3.6.2. Offered Lands - Broken Wing Ranch

3.6.2.1. Surface Water

The ranch is in the Salmon River-Bradshaw Creek 6th level watershed (26,315 acres) (HUC 170602011401). The ranch is primarily along the Salmon River bottom lands, which include the lower reaches/mouths of several small tributary streams (Sink Creek and Lyon Creek, as well as small unnamed tributaries). The ranch is approximately 12 miles downstream of the confluence of S. Creek with the Salmon River. Flows at the nearest active Salmon River gaging station to the ranch (No. 13296500) were previously discussed (Section 3.6.1.1.). There are no known flow records for small tributary streams that drain through the ranch, except in August 1996, as part of the BURP, a flow measurement of 0.7 cfs was made at the mouth of Sink Creek (IDEQ 2010a). The lower portion of Lyon Creek has perennial flow, and there is a diversion from the stream between BWR-1 and BWR-3 for irrigation on BWR-2 and BWR-3.

The Salmon River, where it flows through the ranch, has not been assessed in the most recent IR (IDEQ 2011a). Therefore, it is unknown if this portion of the river fully supports its beneficial uses of cold water aquatic life, primary contact recreation, and salmonid spawning. However, this portion is still afforded Tier II protection under Idaho antidegradation policy. Similarly, Lyon Creek has not been assessed to determine whether its beneficial uses are supported or whether its water quality is impaired. The streambanks along the lower 1,850 feet of Lyon Creek are eroding/sloughing in part due to livestock grazing, vegetation removal, and vehicle fords with little pool habitat.

Sink Creek is considered to be supporting its beneficial uses based upon an assessment in 1996 (IDEQ 2011a). In general, cattle are a major source of fecal coliform, e.g., Tiedemann et al. (1987) found the concentration of fecal coliform indicator bacteria in streamwater in pastures with managed grazing was approximately twice the concentration in streamwater in ungrazed pastures. Approximately 50 percent of the riparian areas at the ranch are fenced to exclude livestock (Figure 3.5-3).

There are nine water rights for the ranch for surface water for irrigation totaling 15.89 cfs, 6.22 cfs from Lyon Creek, 6.56 cfs from the Salmon River, 2.21 cfs from Alkali Spring, and 0.9 cfs from Sink Creek. There is also a water right for the ranch for surface water for stockwater from the Salmon River (0.02 cfs). The BLM, Idaho, and other private entities also have water rights nearby for the Salmon River (IDWR 2012). There are three points of diversion along Lyon Creek, one of which is screened. The screened diversion on lower Lyon Creek was designed for a maximum diversion of 1.39 cfs, and thus the remaining water (2.33 cfs) of the water right (3.72 cfs) for the diversion is currently instream flow. Approximately 300 feet upstream of the confluence of the Lyon Creek and Salmon River a small earthen dam (~ 6 feet in height and ~ 130 feet in width) creates the Lyon Creek pond (~ 0.5 acre).

3.6.2.2. Groundwater

There are seven water rights on the ranch for groundwater for domestic and stockwater use totaling 0.34 cfs. The groundwater is from ten wells; three for irrigation, two for stock, four for domestic use, and one test well (IDWR 2012). The Federal government and several other private entities also have water rights for groundwater in the vicinity.

3.6.2.3. Springs

There is one spring used for portable water on the ranch approximately 600 feet west of the Lyon Creek ranch house (Doughty 2013). There is one spring in the Lyon Creek watershed, approximately ½ mile upstream of the western edge of BWR-1. In addition, Alkali Spring is on the east side of the Salmon River 1 mile east of the mouth of Sink Creek. There are water rights for the ranch for surface water for irrigation (2.21 cfs) and for stockwater (0.03 cfs) from Alkali Spring.

The water right for the latter is held in the name of the BLM because the stockwater use is on BLM land. The BLM also holds a water right for stockwater from Alkali Spring.

3.6.3. Offered Lands - Garden Creek Property

3.6.3.1. Surface Water

The property contains the upper portion (headwaters) of the Garden Creek 6th level watershed (18,560 acres) (HUC 170402080402), which drains the central portion of the south slope of the Bannock Range. Garden Creek is a tributary to Marsh Creek, which drains to the Portneuf River subbasin (HUC 17040208), which ultimately drains to the Upper Snake River subregion (HUC 1704). The Garden Creek property is primarily in uplands at the head of Garden Creek, but also includes a reach of the stream that appears to be supported by a spring just outside of the property. Garden Creek is a perennial stream (~ 2 feet wide with a very narrow riparian corridor) with no known flow records, other than a single flow measurement (1.1 cfs) in July 2002 from a site approximately 5 miles downstream of the property (IDEQ 2010a).

Garden Creek, including the stream reach that flows through the Garden Creek property, is 303(d)-listed for pathogens (*Escherichia coli*) (IDEQ 2011a). Previous 303(d) listings for the concentrations of total nitrogen, total phosphorus, and sedimentation/siltation for Garden Creek were addressed in the Portneuf River TMDL. The current 303(d) listing indicates this portion of Garden Creek does not support cold water aquatic or secondary recreation beneficial uses, though it fully supports an assigned beneficial use for salmonid spawning. There is no known water quality data or water rights for surface water for the portion of Garden Creek on the property. However, the Forest Service and BLM have water rights for Garden Creek upstream of the property for wildlife and downstream of the property for stockwater, respectively.

3.6.3.2. Groundwater

There are no wells or water rights for groundwater on the property (IDWR 2012).

3.6.3.3. Springs

No springs were identified on the property, but a spring is mapped next to Garden Creek 350 feet north of the northeast corner of the property. The discharge from the spring probably flows downstream through the property via Garden Creek. There are no water rights for springs on the property (IDWR 2012).

3.7. Wildlife Resources

The analysis area for wildlife resources for the MMPO alternatives is the S. Creek and Thompson Creek 6th level HUC watersheds (Figure 3.7-1). The analysis area for the land disposal alternatives is the selected and offered lands. Special status wildlife species are also summarized in this section. Special status wildlife species are those listed as proposed, candidate, threatened, or endangered under the ESA by the USFWS, or those listed as sensitive by either the BLM or Forest Service. There are 26 special status wildlife species that fall within the jurisdictions associated with the analysis areas (Table 3.7-1).

Table 3.7-1. Special status wildlife jurisdiction, all analysis areas.

	MMPO Area	Selected Land	Broken Wing Ranch	Garden Crk. property
SPECIES **Common name** *Scientific name*	**BLM Challis and Forest Service Challis-Yankee Fork**	**BLM Challis**	**BLM Challis**	**BLM Pocatello**
MAMMALS				
Canada lynx *Lynx canadensis*	Yes (BLM)	Yes	Yes	No
Gray wolf *Canis lupus*	Yes (BLM)	Yes	Yes	Yes
American pika *Ochotona princeps*	Yes (Forest Service)	No	No	No
Bighorn sheep *Ovis Canadensis*	Yes (Forest Service)	Yes	Yes[1]	No
Fisher *Martes pennanti*	Yes (BLM and Forest Service)	Yes	Yes	No
Pygmy rabbit *Brachylagus idahoensis*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Spotted bat *Euderma maculatum*	Yes (BLM and Forest Service)	Yes	Yes[1]	No
Townsend's big-eared bat *Corynorhinus townsendii*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Wolverine *Gulo gulo*	Yes (BLM and Forest Service)	Yes	Yes	No

	MMPO Area	Selected Land	Broken Wing Ranch	Garden Crk. property
SPECIES **Common name** *Scientific name*	**BLM Challis and Forest Service Challis-Yankee Fork**	**BLM Challis**	**BLM Challis**	**BLM Pocatello**
BIRDS				
Western yellow-billed cuckoo *Coccyzus americanus*	Yes (BLM)	Yes	Yes	No
Greater sage-grouse *Centrocercus urophasianus*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Bald eagle *Haliaeetus leucocephalus*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Boreal owl *Aegolius funereus*	Yes (Forest Service)	No	No	No
Brewer's sparrow *Spizella breweri*	Yes (BLM)	Yes	Yes	Yes
Calliope hummingbird *Stellula calliope*	Yes (BLM)	Yes	Yes	Yes
Flammulated owl *Otus flammeolus*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Great gray owl *Strix nebulosa*	Yes (Forest Service)	No	No	No
Hammond's flycatcher *Empidonax hammondii*	Yes (BLM)	Yes	Yes	Yes
Northern goshawk *Accipiter gentilis*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Olive-sided flycatcher *Contopus borealis*	Yes (BLM)	Yes	Yes	Yes
Peregrine falcon *Falco peregrinus anatum*	Yes (BLM and Forest Service)	Yes	Yes	Yes
Pileated woodpecker *Dryocopus pileatus*	Yes (Forest Service)	No	No	No

	MMPO Area	Selected Land	Broken Wing Ranch	Garden Crk. property
SPECIES **Common name** *Scientific name*	**BLM Challis and Forest Service Challis-Yankee Fork**	**BLM Challis**	**BLM Challis**	**BLM Pocatello**
Three-toed woodpecker *Picoides tridactylus*	Yes (Forest Service)	No	No	Yes[1]
Willow flycatcher *Empidonax traillii*	Yes (BLM)	Yes	Yes	Yes
Williamson's sapsucker *Sphyrapicus thyroideus*	Yes (BLM)	Yes	Yes	Yes
REPTILES AMPHIBIANS				
Columbia spotted frog *Rana luteiventris*	Yes (Forest Service)	No	No	No
Northern leopard frog *Rana pipiens*	No	No	No	Yes
Western toad (N Rocky Mountain) *Bufo boreas*	No	No	No	Yes

[1] Evaluated due to habitat suitability.

3.7.1. MMPO Area and Selected Land

3.7.1.1. Wildlife Habitat

The wildlife habitat in the analysis area is fragmented by historic logging, mining, and roads, and is characterized by generally consistent background human disturbance and noise (Section 3.10.3.3). Most areas are steeply sloped and comprised of either Douglas-fir forest or big sagebrush communities with native grasses and interspersed with rock outcrops or scree areas (Section 3.4.1.2).

Riparian habitats are some of the most important habitat areas for non-game wildlife in the analysis area, as these habitats provide water and high structural diversity (BLM 1999, p. 323). Aspen occurs mainly near streams, and provides important wildlife habitat for beaver (*Castor canadensis*; BLM 1999, p. 284). Willows are an important component of bank stabilization and shading for streams in the analysis area, and provide thermal and hiding cover for wildlife, forage for ungulates and beaver, and non-game habitat (BLM 1999, p. 285). Conifer forests also provide high structural diversity and are important habitats for wildlife, particularly cavity-nesting birds (BLM 1999, p. 323). Forest habitat is very dense in some areas of the selected

land, such as south of Bruno Creek. Sagebrush habitats in the analysis area provide suitable nesting habitat for migratory birds, including sensitive species such as Brewer's sparrow. Rocky outcrops in the analysis area provide nesting habitat for raptors and roosting habitat for bats. Winter range comprises important habitat for big game species. Winter range (typically lower elevations) provides critical foraging and shelter opportunities when food and shelter is scarce across other parts of a big game species range.

3.7.1.2. Special Status Wildlife Species

Surveys to document the presence or absence of special status wildlife species in the analysis area have been limited. Therefore, the potential presence and distributions of most special status wildlife species in the analysis area is inferred from their presence in nearby areas and the presence in the analysis area of habitats where special status wildlife species are normally found. Incidental observations have verified the presence of some species (Figure 3.7-1., Table 3.7-2.) (IDFG 2011a).

Table 3.7-2. Special status wildlife species, MMPO analysis area.

Species (Status)	Occurrence
MAMMALS	
Canada lynx (threatened)	**Possible** Sightings of lynx have been confirmed in Custer County (IDFG 2011a) north and just south of the analysis area. Lynx may pass through the analysis area.
Gray wolf (sensitive)	**Likely** The analysis area contains part of the Yankee Fork wolf activity center (Nadeau et al. 2009) as well as several single wolf observations. Other wolf activity centers are in the vicinity (see wolf activity center map; Nadeau et al. 2009), thus individuals from several packs are likely to pass through the analysis area.
American pika (sensitive)	**Present** Pikas were observed in rock piles and the WRSFs. Pikas may also occur in other rocky habitats in the analysis area.
Bighorn sheep (sensitive)	**Possible** No winter range or crucial habitat for bighorn sheep is available in the analysis area. However, some individuals may move through the area while migrating between seasonal ranges.
Fisher (sensitive)	**Possible** Suitable forest habitat is present. The closest fisher observation was at Rough Creek, ~ 15 miles west of the analysis area (Purvine 2009).

Species (Status)	Occurrence
Pygmy rabbit (sensitive)	**Possible** Some suitable habitat probably occurs in the analysis area. No sagebrush or other shrub stands with friable soils were observed in the MMPO area or selected land during general wildlife surveys, but microhabitat patches of friable soils are likely to occur in some locations. In general, however, soils in the area are too rocky.
Spotted bat (sensitive)	**Possible** Spotted bats are known to occur in Salmon River canyon in the analysis area. Spotted bats may temporarily roost in rock outcrops in the analysis area.
Townsend's big-eared bat (sensitive)	**Possible** The analysis area may contain limited amounts of suitable maternity or hibernacula habitat or caves. It is more likely that Townsend's big-eared bats would forage and roost temporarily in rock outcrops in the analysis area.
Wolverine (sensitive)	**Possible** Wolverines have been observed along the Salmon River in the southernmost portion of the analysis area. They have also been observed northeast and southeast of the analysis area (IDFG 2011a) and may use the habitats in the analysis area for temporary refuge, hunting, or denning.
BIRDS	
Western yellow-billed cuckoo (threatened)	**Possible** No suitable nesting habitat or observations of individuals, but transient individuals might temporarily use riparian habitats.
Greater sage-grouse (candidate)	**Unlikely** Suitable habitat is present but it is unlikely that the MMPO area or selected land is occupied by sage-grouse (Section 3.7.4).
Bald eagle (sensitive)	**Present** An active nest is on S. Creek on private land in the analysis area, 2.5 miles south of the selected land (IDFG 2009a). The nest is adjacent to S. Creek Road, which is used by TCMC employees and haul vehicles. Nesting or migrating bald eagles may forage in the analysis area.
Boreal owl (sensitive)	**Possible** Surveys by IDFG (2007) documented boreal owls in the Boundary Creek watershed ~ 60 miles to the west of the analysis area. Some suitable forest habitat for nesting is in the analysis area.
Brewer's sparrow (sensitive)	**Possible** Suitable habitat for Brewer's sparrow (sagebrush or other shrub steppe) is present.

Species (Status)	Occurrence
Calliope hummingbird (sensitive)	**Possible** Suitable forest edge and riparian habitat is present.
Flammulated owl (sensitive)	**Present** Surveys by IDFG (2007) documented two flammulated owls in the S. Creek watershed in the analysis area (both detections within the selected land), and there were 56 detections in the "south zone" of the SCNF, which includes the northern portion of the analysis area.
Great gray owl (sensitive)	**Possible** Forest Service (2003) records indicate observations from Marsh Creek and Yankee Fork 5th level HUC watersheds, northeast of the analysis area. Some suitable forest habitat for nesting is in the analysis area.
Hammond's flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat is present.
Northern goshawk (sensitive)	**Possible** Some suitable forest habitat is present.
Olive-sided flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat is present.
Peregrine falcon (sensitive)	**Possible** A peregrine aerie is present near the mouth of S. Creek. This aerie was occupied in 2008 and 2009 but unoccupied in 2012 (IDFG 2009b, IDFG 2012a). Peregrine falcons may forage in the analysis area.
Pileated woodpecker (sensitive)	**Possible** Suitable forest habitat is present.
Three-toed woodpecker (sensitive)	**Possible** Suitable spruce forest habitat is present.
Willow flycatcher (sensitive)	**Possible** Suitable riparian habitat is present.
Williamson's sapsucker (sensitive)	**Possible** Suitable forest habitat is present.
REPTILES AMPHIBIANS	
Columbia spotted frog (sensitive)	**Possible** Suitable (riparian) habitat is present.

3.7.1.3. Management Indicator Species

MIS are identified for Forest Service land in the analysis area, such as that associated with the MMPO alternatives (Table 3.7-3.) (USFS 2006). MIS are key species representative of life forms in general, and are species for which populations and habitat objectives can be established and tracked as indicators of habitat capability (USFS 1987).

Table 3.7-3. MIS, NFS land in the analysis area.

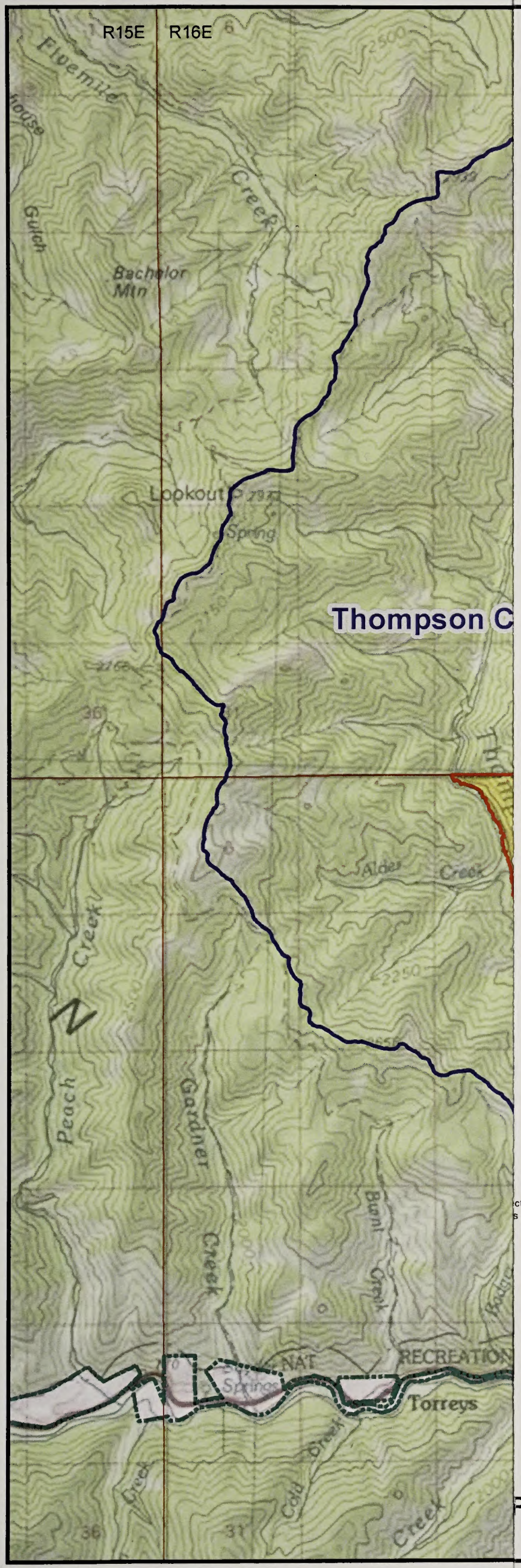
MIS	Habitat	Occurrence
Columbia spotted frog	riparian habitat/community	suitable wet (riparian) habitats
Greater sage-grouse *Centrocercus urophasianus*	sagebrush habitat/community	not expected to occur (Section 3.7.4.)
Pileated woodpecker	coniferous habitat/community	observed in analysis area (USFS 2006)
Bull trout *Salvelinus confluentus*	aquatic habitat/community	may occur in Thompson or S. creeks (Section 3.8.1.1.)

3.7.1.4. General Wildlife

Elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), blue grouse (*Dendragapus obscures*), golden eagle (*Aquila chrysaetos*), and coyote (*Canis latrans*) are common in the analysis area. A cluster of little brown bats (*Myotis lucifugus*) was detected in June 2010 at the Lower Bruno Pond near the mouth of Bruno Creek (JBR 2014e). Game animals and migratory birds are discussed in more detail below.

Big Game

Big game in Idaho is managed by the IDFG. The analysis area is in IDFG Game Management Unit 36B. Mule deer and elk are the most visible species in the analysis area. Pronghorn antelope (*Antilocapra americana*) are occasionally observed, but numbers are low (BLM 2003). Bighorn sheep and mountain goats (*Oreamnos americanus*) have been observed in Unit 36B but are not common in the analysis area. Incidental counts of bighorn sheep during elk surveys identified 117 bighorn sheep across Unit 36B in 2010.



Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

HUC 12 Boundaries

- Lower S. Creek
- Thompson Creek

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:72,000 12,000

Feet

0 3

Kilometers

cted land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
s at 1:24,000 and created and maintaned by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Background from USGS 1:100,000-scale metric topographic maps
HUC boundaries from USDA/NRCS - National Geospatial Management center, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.7-1
PO alternative analysis area, wildlife resources
Thompson Creek Mine EIS

3.7.1.3. Management Indicator Species

MIS are identified for Forest Service land in the analysis area, such as that associated with the MMPO alternatives (Table 3.7-3.) (USFS 2006). MIS are key species representative of life forms in general, and are species for which populations and habitat objectives can be established and tracked as indicators of habitat capability (USFS 1987).

Table 3.7-3. MIS, NFS land in the analysis area.

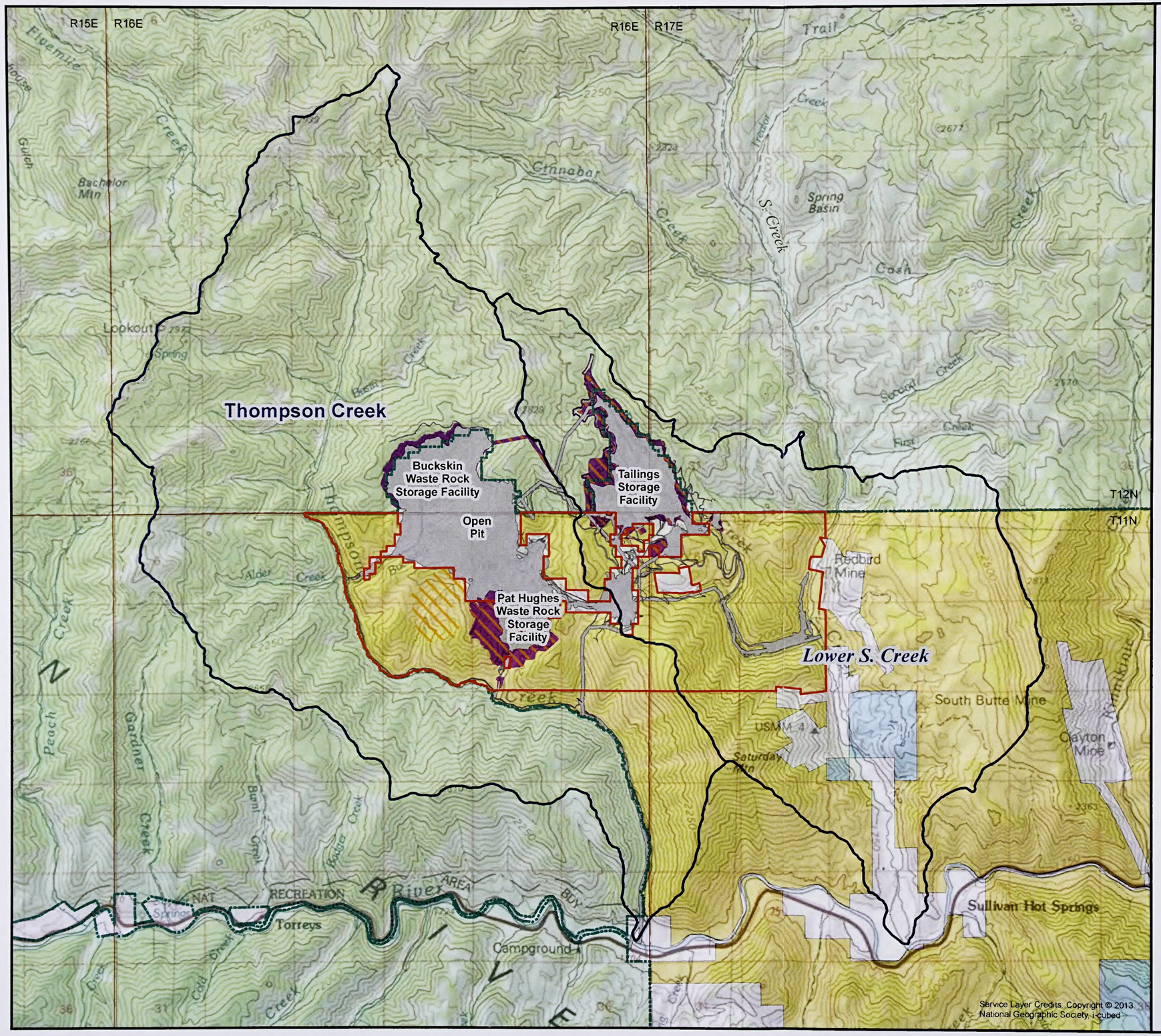
MIS	Habitat	Occurrence
Columbia spotted frog	riparian habitat/community	suitable wet (riparian) habitats
Greater sage-grouse *Centrocercus urophasianus*	sagebrush habitat/community	not expected to occur (Section 3.7.4.)
Pileated woodpecker	coniferous habitat/community	observed in analysis area (USFS 2006)
Bull trout *Salvelinus confluentus*	aquatic habitat/community	may occur in Thompson or S. creeks (Section 3.8.1.1.)

3.7.1.4. General Wildlife

Elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), blue grouse (*Dendragapus obscures*), golden eagle (*Aquila chrysaetos*), and coyote (*Canis latrans*) are common in the analysis area. A cluster of little brown bats (*Myotis lucifugus*) was detected in June 2010 at the Lower Bruno Pond near the mouth of Bruno Creek (JBR 2014e). Game animals and migratory birds are discussed in more detail below.

Big Game

Big game in Idaho is managed by the IDFG. The analysis area is in IDFG Game Management Unit 36B. Mule deer and elk are the most visible species in the analysis area. Pronghorn antelope (*Antilocapra americana*) are occasionally observed, but numbers are low (BLM 2003). Bighorn sheep and mountain goats (*Oreamnos americanus*) have been observed in Unit 36B but are not common in the analysis area. Incidental counts of bighorn sheep during elk surveys identified 117 bighorn sheep across Unit 36B in 2010.



Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3

HUC 12 Boundaries

- Lower S. Creek
- Thompson Creek

Land Ownership

- BLM
- Private
- State
- Forest Service

N

0 1:72,000 12,000 Feet

0 3 Kilometers

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Background from USGS 1:100,000-scale metric topographic maps
HUC boundaries from USDA/NRCS - National Geospatial Management center, 2012

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.7-1
MMPO alternative analysis area, wildlife resources
Thompson Creek Mine EIS

Mule Deer

A relatively high number of mule deer (8,720) were observed in Unit 36B in 2011 (Gaughan 2012, Gaughan 2014a). Unit 36B and several of the adjacent units to the north contain the majority of the most productive mule deer units in the region. The relatively high mule deer productivity is probably due to low competition from other ungulate species because white-tailed deer (*Odocoileus virginianus*) are mostly restricted to private land along major riparian areas, and the ranges of antelope, bighorn sheep, and mountain goats generally do not overlap with those of mule deer (Rachael et al. 2010a).

Mule deer are common throughout the analysis area, including areas close to human activity (e.g., roads) (BLM 1999). Preferred mule deer habitat is in timbered or brushy areas (hiding cover) mixed with sagebrush-grass and mountain mahogany (*Cercocarpus ledifolius*) foraging sites (BLM 1999). Approximately 94 percent of the analysis area is mule deer winter range. No mule deer migration corridors are known in the analysis area (BLM 1999, Map 22). Approximately 150 mule deer spend the winter between Thompson Creek and S. Creek (Wolf 2010).

Elk

A 2010 survey found 1,097 elk in Unit 36B (Wolf 2010, Gaughan 2014a). In 2008 there were 866 elk, a decrease of 55 percent compared to the 2005 estimate of 1,914 (Rachael et al. 2010b). Elk generally prefer areas away from roads with abundant timbered or brushy areas (hiding cover) and open sagebrush-grassland foraging sites. Important hiding cover includes timber stands, patches of mountain mahogany, riparian zones, and rugged terrain (BLM 1999). However, elk have become habituated to human activity at the mine site and commonly forage next to the Bruno Creek Road. Approximately 98 percent of the analysis area is elk winter range. No elk migration corridors are known in the analysis area (BLM 1999, Map 21). Approximately 90 to 130 elk spend the winter between Thompson Creek and S. Creek (Wolf 2010).

Black Bear and Mountain Lion

Black bears (*Ursus americanus*) typically occupy both forested and riparian habitats. The IDFG black bear data analysis unit (DAU) 1J, which includes Unit 36B, contains some of the best black bear habitat in the Salmon Region, and black bear are harvested annually (White et al. 2009). Therefore, black bear probably occur in the analysis area. The IDFG Salmon Region/Salmon DAU, which includes Unit 36B, supports abundant mountain lion (*Puma concolor*) prey species such as deer, elk, bighorn sheep, and mountain goat, and mountain lion are common (White et al. 2010). Therefore, mountain lion probably occur in the analysis area.

Migratory Birds

There are three types of suitable habitat for migratory birds in the analysis area (Table 3.7-4.) and migratory birds likely utilize these habitats during certain portions of the year.

Table 3.7-4. Migratory bird habitats, analysis area.

Migratory Bird Habitats	Portion of Analysis Area	Occurrence
Riparian	selected land	49 acres willow/alder shrub
	MMPO area	none
Douglas-fir	selected land	901 acres Douglas-fir 418 acres mixed Douglas-fir/lodgepole pine
	MMPO area	133 acres Douglas-fir 31 acres mixed Douglas-fir/lodgepole pine
Sagebrush scrub	selected land	1,225 acres big sagebrush + low sagebrush
	MMPO area	61 acres big sagebrush

3.7.2. Broken Wing Ranch

3.7.2.1. Wildlife Habitat

Most of the valley areas at the ranch are cultivated or otherwise disturbed for agricultural use. There are scattered cottonwoods along the Salmon River corridor. Lyon Creek has a more developed riparian corridor with large black cottonwoods, willows, and other riparian shrubs. Foothills contain varying amounts of bare ground (gravel/cobble substrate) and vegetation, including scattered sagebrush, shadscale, and native grasses (Section 3.4.2.2).

The ranch provides good foraging habitat for raptors nesting in the vicinity. Large cottonwood trees along the Salmon River and Lyon Creek provide roosting perches, particularly for bald eagles during winter. Migratory birds would be expected to use the riparian vegetation for nesting or as temporary roosting and foraging. In general, the riparian and adjacent habitat along Lyon Creek is high-quality bird habitat (BLM 2009b).

3.7.2.2. Special Status Wildlife Species

A variety of special status wildlife species occur or may occur at the ranch (Table 3.7-5).

Table 3.7-5. Special status wildlife species, Broken Wing Ranch.

Species (Status)	Occurrence
MAMMALS	
Canada lynx (threatened)	**Possible** Within secondary habitat for Canada lynx as mapped by the Forest Service (USFS 2007); although unlikely, lynx may pass through or forage at the ranch.
Gray wolf (sensitive)	**Possible** No members of any wolf pack or individual wolf are known to use the ranch, but the Buffalo Ridge wolf pack activity center is near the west part of the ranch (Nadeau et al. 2009). Therefore, individuals or packs may pass through the ranch.
Bighorn sheep (sensitive)	**Possible** 15 % of the ranch is in bighorn sheep winter range (the upper elevations around Lyon Creek).
Fisher (sensitive)	**No** No suitable habitat.
Pygmy rabbit (sensitive)	**Likely** Pygmy rabbits likely occur within and adjacent to the ranch, where friable soils and sagebrush cover are present within toe slopes above the agricultural fields (Waterbury 2014).
Spotted bat (sensitive)	**Possible** Roost habitat is present around the ranch and river and meadow/fields associated with the ranch. It is possible that spotted bats would use the ranch for foraging.
Townsend's big-eared bat (sensitive)	**Possible** Suitable habitat in the form of rocky outcrops and caves for maternity roosts and hibernacula are not present on the ranch, but Townsend's big-eared bats may roost in the vicinity and forage in riparian areas on the ranch.
Wolverine (sensitive)	**No** No suitable habitat.
BIRDS	
Western yellow-billed cuckoo (threatened)	**Possible** No suitable nesting habitat or observations of individuals, but transient individuals might temporarily use riparian habitats.
Greater sage-grouse (candidate)	**Likely** Suitable habitat occurs on the ranch, within foothills surrounding the ranch parcels (sagebrush with small areas of grassland) and within the areas of irrigated agricultural land.
Bald eagle (sensitive)	**Present** Bald eagles have been observed along the Salmon River and at the ranch (IDFG 2011a).

Species (Status)	Occurrence
Brewer's sparrow (sensitive)	**Possible** Suitable sagebrush habitat (BLM 2009b, Area A) is present.
Calliope hummingbird (sensitive)	**Possible** Suitable riparian habitat (BLM 2009b, Area A) is present.
Flammulated owl (sensitive)	**No** No suitable habitat.
Hammond's flycatcher (sensitive)	**No** No suitable habitat.
Northern goshawk (sensitive)	**No** No suitable habitat.
Olive-sided flycatcher (sensitive)	**No** No suitable habitat.
Peregrine falcon (sensitive)	**Possible** Peregrine falcons may use the ranch for foraging.
Willow flycatcher (sensitive)	**Possible** Suitable riparian habitat (BLM 2009b, Area A) is present.
Williamson's sapsucker (sensitive)	**No** No suitable habitat.

3.7.2.3. General Wildlife

Wildlife common on the ranch include big game (elk, mule deer), game birds (chukar and blue grouse), and migratory birds using riparian and sagebrush habitats. Raptors are expected to roost and forage in the area because rock and forest habitat suitable for nesting is in the vicinity.

Big Game

The majority (west of the Salmon River) of the ranch is in IDFG Unit 36B. The big game species of this unit were previously described (Section 3.7.1.4).

Elk, Deer, and Big Horn Sheep

The portions of the ranch east of the Salmon River are in Unit 36A. The most recent elk count for this unit was 3,649 in 2013 (Gaughan 2014b), which is at or above objectives (Section 3.7.1.4.) and a 74 percent increase in the count from 2008 ([2,095] Rachael et al 2010b). There were 4,711 mule deer counted in the unit in 2011 (Gaughan 2012, Gaughan 2014a). The entire ranch is crucial winter range for mule deer. In addition, 10 percent of the ranch is winter range for elk, and 15 percent of the ranch is winter range for bighorn sheep. There are no big game migration corridors through the ranch. Approximately 60 to 70 elk and 200 mule deer spend the winter in the Lyon Creek drainage (Wolf 2010, 2011).

Black Bear and Mountain Lion

Black bear and mountain lion probably occur on the ranch for foraging and hunting, but due to the level of agricultural development and human disturbance it is improbable that these animals would utilize the ranch for denning.

Migratory Birds

The ranch contains three habitats suitable for migratory birds: agricultural land (the majority of the ranch), riparian (7 acres of willow, i.e., shrub-dominated riparian and 26 acres of willow/cottonwood along the Salmon River), and sagebrush scrub (260 acres, big sagebrush only). Migratory birds probably utilize these habitats during certain portions of the year.

3.7.3. Garden Creek Property

3.7.3.1. Wildlife Habitat

The property is densely forested in most areas, with mixed aspen and conifer trees in various stages of growth (< 100 years). Some dead trees and other woody debris are present, with a thick understory of shrubs and very young trees (saplings) in some places. The property has a few open, less steep areas with grasses and forbs. However, the majority of the property is fairly steep. Garden Creek crosses the upper northwest corner of the property and is approximately 2 feet wide with a very narrow riparian corridor. Forested areas provide raptor nesting habitat for goshawk and sensitive owls. The property likely has a fairly diverse bird population due to its location at the headwaters of Garden Creek, and the presence of forest habitat with a developed shrub layer. Amphibians may utilize the stream margins. The riparian area and forest openings provide foraging habitat for bats.

3.7.3.2. Special Status Wildlife Species

A variety of special status wildlife species occur or may occur at the property (Table 3.7-6).

Table 3.7-6. Special status wildlife species, Garden Creek property.

Species (Status)	Occurrence
MAMMALS	
Gray wolf (sensitive)	**No** No known wolf packs in the vicinity of the property.
Pygmy rabbit (sensitive)	**No** No sagebrush or other shrub stands with friable soils are present on the property.
Townsend's big-eared bat (sensitive)	**Present** No suitable maternity or hibernacula habitat, or caves, cliffs suitable for roosting, but Townsend's big-eared bats forage on the property in riparian areas and forest openings and were detected on the property on 22-23 June 2010 (JBR 2014e).
BIRDS	
Western yellow-billed cuckoo (threatened)	**No** Transient individuals are not expected.
Greater sage-grouse (candidate)	**No** No suitable habitat.
Bald eagle (sensitive)	**No** No suitable habitat.

Species (Status)	Occurrence
Brewer's sparrow (sensitive)	**No** No suitable habitat.
Calliope hummingbird (sensitive)	**Possible** Suitable forest edge and wooded hillside habitat.
Flammulated owl (sensitive)	**Possible** Suitable forest habitat and the closest observations of the species are 3 miles north and 7 miles northwest of the property (IDFG 2011a).
Hammond's flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat.
Northern goshawk (sensitive)	**Possible** Suitable forest habitat and the closest observations of the species are 5 miles north and 3 miles east of the property (IDFG 2011a).
Olive-sided flycatcher (sensitive)	**Possible** Suitable high-elevation forest habitat.
Peregrine falcon (sensitive)	**No** No suitable nesting habitat.
Three-toed woodpecker (sensitive)	**Possible** Suitable forest habitat is present.
Willow flycatcher (sensitive)	**Possible** Suitable riparian habitat is present.
Williamson's sapsucker (sensitive)	**Possible** Suitable forest habitat is present.
REPTILES AMPHIBIANS	
Northern leopard frog (sensitive)	**Possible** Suitable (riparian) habitat is present.
Western toad (sensitive)	**Possible** Suitable riparian and terrestrial habitat is present.

3.7.3.3. General Wildlife

Big Game

The Garden Creek property is in IDFG Game Management Unit 70, and does not contain winter range for any big game species.

Elk and Deer

IDFG Unit 70 and the surrounding region comprise the least productive area in southeast Idaho for mule deer, mainly due to the conversion of perennial grasslands to shrublands and forest, and due to the encroachment of human activity into winter ranges. There is no winter range on the Garden Creek property. The mule deer population in Unit 70 was 3,278 (± 153) in 2008

(Class 2010, 2011). The elk population in the unit was 100 cows and 65 bulls in 2010, which was above objectives. However, incidental observations during mule deer counts in 2008 suggest there may be as many as 400 elk in the unit during some years (Class 2010, 2011).

Black Bear and Mountain Lion

It is unlikely that black bear den on the property because of lack of suitable terrain, but black bear are known to occur on the property, e.g., a black bear was observed on the property during a field inspection in August 2009 (JBR 2014e). The property is not in an IDFG black bear DAU (White et al. 2009). Mountain lions are also unlikely to den on the property due to lack of suitable terrain, but probably hunt on the property. The property is in the Southeast Region/Pocatello mountain lion DAU (west district). Concern over mountain lion depredation on the mule deer population in the west district has prompted relatively higher harvest quotas for mountain lions in that district (White et al. 2010).

Migratory Birds

The property contains two habitats suitable for migratory birds: riparian (< 1 acre of forested riparian corridor) and Douglas-fir (64 acres). Migratory birds likely utilize these habitats during certain portions of the year.

Bats

Eight species of bats were detected in one location on the property in 2010: Townsend's big-eared bat, hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), western small-footed myotis (*Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), little brown myotis, long-legged myotis (*Myotis volans*), and Yuma myotis (*Myotis yumanensis*) (JBR 2014e).

3.7.4. Special Status Wildlife Species, All Analysis Areas

Basic information on special status wildlife species was provided in each of the three main subsections (MMPO area/selected land, Broken Wing Ranch, Garden Creek property) above. More detailed information is provided below.

Canada Lynx (Threatened)

Analysis Areas: All

The Canada lynx was listed as threatened in the contiguous US under the ESA in 2000. Lynx analysis units (LAUs) have been identified by the Forest Service and are used to analyze the effects of a project to lynx productivity, mortality risk factors, movement, and dispersal. The area of an LAU is the approximate area used by individual lynx, not an actual home range, and includes all seasonal habitats. A small portion of the selected land (38 acres) is in the Thompson-Lower S. LAU.

In the western US, lynx occur primarily in Douglas-fir, spruce-fir, and fir-hemlock forests between approximately 5,000 feet to 6,500 feet elevation. The distribution of lynx is very similar to that of snowshoe hares, and lynx tend to occur where snowshoe hare density is highest (Aubry et al. 2000). Snowshoe hares occur in early successional stands with high stem densities. In southern boreal forests, alternative prey for lynx (especially red squirrels) is also important. However, in southern boreal forests, such habitats appear to be used by lynx primarily for

hunting; all known den sites in southern regions were in mature forest stands with large woody debris. Denning habitat may be root wads, wind-thrown piles, or large down trees. Relatively large home ranges appear to be characteristic of lynx in southern boreal forests (Aubry et al. 2000).

The SCNF is part of "secondary" lynx habitat as defined in the Northern Rockies Lynx Amendment (USFS 2007). Secondary habitat has relatively few and more sporadic current and historical records of lynx compared to primary or "core" habitat, and reproduction in secondary habitat has not been documented (USFS 2007). The nearest lynx core habitat is more than 150 miles east and north of the portions of the SCNF in the analysis areas (USFS 2007). A male lynx was incidentally trapped and released in the Williams Creek drainage, approximately 11 miles southwest of Salmon, on January 26, 2012 (Waterbury 2012). This occurrence, approximately 50 miles northeast of the MMPO area, is the first verified occurrence of lynx in the Upper Salmon River drainage since 1991. Lynx may pass through the MMPO area, selected land, or the Broken Wing Ranch (secondary lynx habitat). However, lynx would not occur at the Garden Creek property because this area is not core, secondary, peripheral or linkage habitat for lynx (USFS 2007). The CTNF contains the closest linkage habitat (and mapped LAUs), 45 miles east/southeast of the property.

Gray Wolf (Sensitive)

Analysis Areas: All

The Northern Rocky Mountain population of gray wolves was delisted as an endangered species under the ESA on May 5, 2011 (76 FR 25590-25592). Gray wolves are now managed in Idaho by the IDFG as a game animal under the 2002 Wolf Conservation and Management Plan (Idaho Legislature 2002).

Wolves are social animals, frequently traveling and hunting in family packs of 2 to 12 wolves. Packs typically occupy and defend territories of 20 to 214 square miles. Wolves prey on a wide variety of medium-sized and large mammals, including white-tailed and mule deer, elk, caribou (*Rangifer* sp.), bighorn sheep, mountain goats, and beaver (68 FR 15804-15875). Wolves require habitat suitable for denning (i.e., areas with sufficient vegetative cover and isolation from human activity), and rendezvous sites for resting and gathering (i.e., meadows adjacent to forested areas), and accessibility to prey species. Idaho wolf numbers have grown steadily since the mid-1990s (76 FR 25590-25592). By the end of 2010 at least 705 wolves and 87 resident wolf packs were documented in Idaho (Holyan et al. 2011).

The MMPO area and selected land are in the territory of the Yankee Fork and Buffalo Ridge wolf packs. The Broken Wing Ranch is not in the known territory of a wolf pack, but the ranch is very near the known territory of the Buffalo Ridge pack. Therefore, it is possible wolves may occasionally pass through the ranch. Wolves are not expected on the Garden Creek property because there are no known wolf packs in the area (IDFG-NPT 2012).

American Pika (Sensitive)

Analysis Areas: MMPO Area

The American pika was petitioned for listing under the ESA in October 2007, and in January 2010 the USFWS found that listing the American pika was not warranted (75 FR 6438-6471). However, the pika remains a Forest Service sensitive species.

Pikas are small, vocal members of the rabbit family that live in talus (rocky) fields, or similar human-made habitat such as mine waste rock piles, lumber piles, stone walls, rockwork dams, and structure foundations. Pikas are patchily distributed in cool, rocky habitats (usually alpine) in western Canada and the western US. Pika distribution ranges from sea level to 9,850 feet in the northern part of pika distribution (southwestern Canada), but in the southern extent (New Mexico, Nevada, and Southern California) populations rarely exist below 8,200 feet. In Idaho the Northern Rocky Mountain subspecies (*Ochotona princeps princeps*) is broadly distributed and occupies many sites throughout much of the state. Pikas rely on gathered hay piles of summer vegetation to persist through the winter and do not hibernate. Thermoregulation is an important aspect of pika physiology and thus habitat selection, as hyperthermia (elevated body temperature) or death can occur after brief exposures to temperatures more than 78 °F (75 FR 6440-6441). Pikas occupy the current WRSFs at the mine; several pikas were observed in the WRSFs during wildlife species surveys in 2010 (JBR 2014e). Therefore, it is likely pikas would occur in the current and expanded Buckskin and Pat Hughes WRSFs and the No Name WRSF (Alternative M3 only) in the MMPO area.

Bighorn Sheep (Sensitive)

Analysis Areas: MMPO Area, Broken Wing Ranch

Bighorn sheep are a BLM and Forest Service sensitive species, and managed by the IDFG as big game in the Idaho game management units. This species is also given special consideration in land use planning and other BLM actions.

The habitats for bighorn sheep are diverse but generally mountainous. Bighorn sheep prefer open habitat with good visibility and high-nutrient forage with adjacent, rugged, escape terrain (IDFG 2010a). However, the Middle Main Salmon River population management unit contains some of the least rugged terrain in eastern Idaho (IDFG 2010a). Summer ranges are primarily higher elevations in sub-alpine regions. Winter ranges are dominated by sagebrush and grassland habitats with low precipitation (Toweill et al. 2008). Bighorn sheep winter along the Salmon River corridor in the Middle Main Salmon River population management unit. Some individuals remain in the corridor during summer, whereas others migrate to higher elevation sub-alpine and alpine habitats.

From 1989 to1991 bighorn sheep populations in the Salmon River region rapidly declined by 30 to 50 percent, followed by several years of very low lamb births. Recent aerial surveys suggest lamb numbers are still low (25 lambs/100 ewes). In general, bighorn sheep populations may be stabilizing with some populations increasing (Toweill et al. 2008).

The Salmon River region has had a very active bighorn sheep capture and translocation program since 1974. For example, the IDFG released eight bighorn sheep from Panther Creek to an area

near Birch Creek southwest of Challis in 1982. This translocation was an attempt to stimulate growth of a small, stable population in Unit 36B. Aerial surveys of bighorn sheep were conducted in Unit 36A and Unit 36B during July 2007 to June 2008. There were 108 bighorn sheep in the Morgan Creek area of Unit 36B and 22 bighorn sheep in the Birch Creek area of the unit in 2008 (Toweill et al. 2008). Bighorn sheep may move through the MMPO area or the upper elevations of the Lyon Creek area of the Broken Wing Ranch.

Fisher (Sensitive)

Analysis Areas: MMPO Area, Selected Land, and Broken Wing Ranch

Fishers are agile, carnivorous, aggressive hunters that are members of the weasel family. Suitable fisher habitat includes continuous-canopied, mature to old-growth spruce-fir forest for denning, and areas with dense understories of young conifers, shrubs and herbaceous cover for hunting and foraging (Ruggerio et al. 1994). In Idaho fishers occur in a mosaic of mesic conifer, dry conifer, and sub-alpine forests in the northern and central parts of the state (IDFG 2005b). Fishers use mature and old-growth forests during summer, and young and old-growth forests during winter (Groves et al. 1997). Forested riparian habitat is also important (IDFG 2005b). Fishers may occur in the MMPO area or at the selected land, but are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Pygmy Rabbit (Sensitive)

Analysis Areas: All

Pygmy rabbits exhibit extremely specialized habitat requirements, and thus occupy only a small subset of locations within their range, which extends throughout the Great Basin (75 FR 60516). Pygmy rabbits are limited to sagebrush habitat characterized by tall (often > 6 feet), dense sagebrush plants, and deep, friable soils for digging burrows. In Idaho, pygmy rabbits are found in mima mound areas, which are low, circular mounds of loose, unstratified soils that support distinctly taller patches of sagebrush (IDFG 2005). In the Salmon area, pygmy rabbits are found on alluvial plains dotted with mima mounds approximately 20 to 30 feet in diameter, 1 to 2 feet tall, and several hundred feet apart, where the sagebrush is taller than in the surrounding inter-mound spaces (75 FR 60516).

The analysis area is just west of the westernmost extent of predicted pygmy rabbit distribution mapped by the IDFG (2006). No pygmy rabbits were found within the westernmost surveyed areas of suitable habitat, which are west and southwest of the Broken Wing Ranch. The closest of the surveyed areas is 4 miles east of the analysis area. No suitable habitat for pygmy rabbit was observed within the MMPO area or selected land; however, some suitable microhabitat patches probably occur within the analysis area. Small, "peripheral" populations of pygmy rabbits may occur within the analysis area (most likely east and southeast of the selected land within the S. Creek 6th level HUC watershed) as the analysis area is expected to contain patches of suitable microhabitats and the area is adjacent to a large, contiguous habitat stronghold and expected pygmy rabbit population zone as mapped by the IDFG (2006). There were two separate observations of pygmy rabbits along S. Creek Road in 2006, 1.5 miles southeast of the selected land (IDFG 2006) but within the MMPO area.

Pygmy rabbits likely occur within and adjacent to the ranch, where friable soils and sagebrush cover are present within toe slopes above the agricultural fields (Waterbury 2014). The ranch is within the "extensive, largely contiguous, and secure habitat stronghold for pygmy rabbits" that includes most of the lands in the Challis Field Office area (IDFG 2006). Pygmy rabbits are not expected to occur on the Garden Creek property due to a lack of sagebrush or other shrub stands with friable soils.

Spotted Bat (Sensitive)

Analysis Areas: MMPO Area, Selected Land, and Broken Wing Ranch

Spotted bats are rare and have a highly fragmented distribution, occupying a variety of habitats, from desert to montane forest (including pinyon-juniper woodlands), ponderosa pine (*Pinus ponderosa*), open pasture, and coniferous forest up to 8,000 feet elevation (Groves et al. 1997). Spotted bats roost in deep rock crevices in canyon walls and cliffs. The bats are thought to migrate south during the winter but seasonal movements and winter activity are not well known. The bats forage primarily over dry, open coniferous forest associated with riparian or wet meadows. Individual bats are solitary during the active period and appear to maintain exclusive foraging areas, although they tolerate overlap from other spotted bats. In Idaho spotted bats occur mainly in the southwest corner of the state (Perkins and Peterson 1997) in deep, narrow canyons. However, spotted bats have been reported in the Salmon River Canyon (IDFG 2005b). Therefore, spotted bats may occur at the MMPO area, selected land, and Broken Wing Ranch due to habitat suitability and observations of spotted bats in the region of these areas (Salmon River Canyon).

Townsend's Big-Eared bat (Sensitive)

Analysis Areas: All

Townsend's big-eared bats occur in much of western North America in a variety of habitats and over a wide range of elevations. During the summer these bats roost in abandoned mines, caves, and occasionally in empty or occupied buildings or bridges. Hibernacula (winter shelter) occur exclusively in caves and mine tunnels (Groves et al. 1997) and most roost sites in Idaho are caves (Groves 1992). Populations in Idaho occur predominantly on the Snake River Plain, but scattered populations have been reported throughout the state (IDFG 2005b). Only two maternity colonies have been confirmed in Idaho; both are in Craters of the Moon National Monument. Numerous hibernacula in lava tube caves have been identified in south central and southeast Idaho (IDFG 2005b). Townsend's big-eared bats may occur in all of the analysis areas and were observed at the Garden Creek property (Table 3.7-6). Because there is no roosting habitat on the property, bats are probably foraging in the riparian corridor.

Wolverine (Sensitive)[12]

Analysis Areas: MMPO Area, Selected Land, and Broken Wing Ranch

In North America, wolverines occur in a wide variety of arctic and alpine habitats, but primarily in boreal forests, tundra, and mountains. A general trait of areas occupied by wolverines is the

[12] The wolverine was listed as a candidate species under the ESA on December 10, 2010 (75 FR 78030), and evaluated as such in the DEIS. The wolverine was removed from the candidate list on August 13, 2014 (79 FR 47522), and is thus evaluated as a sensitive species in the FEIS.

remoteness of the areas from humans and human developments (Banci 1994). The southern portion of the wolverine range extends into Idaho (73 FR 12929-12941), where the wolverine is a wide-ranging species throughout mountainous areas. Potential wolverine habitat includes tundra and coniferous forest zones at higher altitudes in summer, and at mid- to lower elevations in winter. Den sites for wolverine in Idaho have most often been linked to talus and boulder fields in remote areas at higher elevation (Ruggiero et al. 1994). During a winter survey on the SCNF, wolverines were found principally in mixed conifer habitat dominated by lodgepole pine, and used spruce-fir stands along stream bottoms and adjacent meadows (Bachman et al. 1990). Wolverines may occur in the MMPO area and at the selected land. Wolverines are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Western yellow-billed cuckoo (Threatened)

Analysis Areas: MMPO Area, Selected Land, and Broken Wing Ranch

The western population of the yellow-billed cuckoo was listed as threatened on October 3, 2014 (79 FR 59992). The distinct population segment (DPS) listed covers twelve western states including Idaho. There are four areas in Idaho recently proposed for designation as critical habitat (79 FR 48548). The closest is approximately 70 miles south of the mine (Big Wood River, Blaine County).

The western yellow-billed cuckoo nests in dense, deciduous, streamside forests. Most nesting occurs within relatively large patches (25+ acres) of riparian forest containing cottonwoods or willows. The most recent, relatively comprehensive survey of yellow-billed cuckoos in Idaho indicates that yellow-billed cuckoos are rare migrants and summer residents, and that the majority of sightings are in the Snake River corridor in the southeast part of the state (Reynolds and Hinckley 2005). In central Idaho over the past 15 years, transient birds have been observed in Penal Gulch (near Challis) and one bird was heard north of Salmon (Idaho Bird Records Committee 2012, Reynolds and Hinckley 2005). No yellow-billed cuckoos were observed in Penal Gulch by Reynolds and Hinckley (2005); the habitat lacks the thick understory preferred by the species and that historic sightings were probably migrant, vagrant, or transient birds.

No yellow-billed cuckoos have been recorded in the MMPO area, selected land, or Broken Wing Ranch. However, based on the sightings described above, migrant, vagrant, or transient individuals might possibly move through the riparian habitats along Thompson Creek, S. Creek, or the Salmon River. Due to the unlikelihood of this species' occurrence and the "No Effect" determination in the draft Biological Assessment, however, the yellow-billed cuckoo will not be carried forward in the EIS.

Greater Sage-grouse (Candidate)

Analysis Areas: All

The greater sage-grouse was assigned a Candidate Listing Priority Number of 8, where 1 is the highest priority (75 FR 13910). On December 27, 2011, the BLM issued Instruction Memoranda No. 2012-043 and No. 2012-044 to provide interim management policies and procedures for sage-grouse, to be applied to ongoing and proposed authorizations and activities that affect the species and its habitat.

Greater sage-grouse depend on sagebrush, particularly big sagebrush and silver sagebrush (*Aretemisia cana*), for food and cover year-round. Sage-grouse utilize riparian and upland meadows and sagebrush grasslands during summer, sagebrush-dominated rangelands with herbaceous cover during breeding (lekking, nesting, and early brood-rearing), and upland meadows, riparian areas, greasewood bottoms, and agricultural fields in addition to sagebrush during autumn (Connelly et al. 2004). Preliminary priority habitat (PPH) is area with the highest conservation value to maintain sustainable greater sage-grouse populations. PPH includes breeding, late brood-rearing, and winter concentration areas. Preliminary general habitat (PGH) is area outside of PPH that is occupied seasonally or year-round.

Habitat for sage-grouse occurs within the MMPO area and the selected land. Shrubland cover, the majority of which is mountain big sagebrush, Wyoming big sagebrush, and low sagebrush, comprises 61.8 acres (13 %) of the MMPO area and 1,229.7 acres (24 %) of the selected land. The lower elevation areas in the MMPO and selected land are suitable for greater sage-grouse (JBR 2014e). However, the MMPO and selected land is not considered valuable sage-grouse habitat. Habitat within the analysis area for MMPO alternatives does not fall within PPH or PGH; the closest mapped PGH for greater sage-grouse is 3 miles east of the MMPO area (BLM 2012c). There have been no documented occurrences of sage-grouse individuals or leks within the MMPO area or selected land. Furthermore, the Forest Service has not identified any seasonal sage-grouse habitat within the MMPO areas under their jurisdiction and "does not consider this area suitable sage-grouse habitat" (Purvine 2014). Therefore, it is unlikely that the MMPO area or selected land is occupied by sage-grouse, even though it contains sagebrush habitat.

Habitat for sage-grouse occurs within foothills surrounding the Broken Wing Ranch parcels and within the areas of irrigated agricultural land, and is likely occupied by sage-grouse. The ranch is within PGH and PPH (BLM 2012c) and, as such, should be considered part of a larger area of intact sage-grouse habitat that is important for sustaining sage-grouse populations into the future. The ranch is part of an important movement and migration area for sage-grouse. The ranch is on the northwestern border of a large, mostly connected area of sagebrush habitat that extends at least 100 miles from Challis, southeast toward Pocatello. The closest known sage-grouse leks to the ranch are clustered about 5 miles to the southeast (BLM 2012c). Sage-grouse are not expected on the Garden Creek property due to the lack of sage-grouse habitat.

Bald Eagle (Sensitive)

Analysis Areas: All

The USFWS estimates that the bald eagle population in the lower 48 states increased from 487 breeding pairs in 1963 to 9,789 breeding pairs in 2007. The bald eagle is protected under the Bald and Golden Eagle Protection Act (16 USC 668-668c) and the MBTA. In addition, the USFWS issued National Bald Eagle Management Guidelines (72 FR 31156) with recommended conservation measures to minimize adverse effects to the bald eagle.

Bald eagle nests as well as communal night roosts are usually located in uneven-aged (multi-storied) stands with old-growth components and near water bodies which support an adequate food supply. In Idaho large cottonwoods, ponderosa pine, and Douglas-fir are the preferred

nesting trees (IDFG 2008b). Wintering eagles perch on a variety of substrates, but typically in trees that provide high vantage points near feeding areas. Isolation is also an important feature of bald eagle wintering habitat. Adequate food sources are the most critical components of bald eagle breeding and wintering habitat. Fish, waterfowl, rabbits, and carrion (including big game carrion in Idaho) comprises the majority of the bald eagle diet (IDFG 2008b, USFWS 1986).

The bald eagle population in Idaho is stable to increasing, thus currently unoccupied suitable habitat is expected to be colonized by an ever-expanding number of bald eagles (Sallabanks 2006). Mid-winter bald eagle counts in the Salmon/Challis area increased each year between 1980 and 2005, from a low of 7 in 1980 to a high of 137 in 2005 (USFS 2006). A bald eagle nest occurs along S. Creek on private land 2.5 miles south of the selected land. The nest was first detected in 2009 and was active (IDFG 2009a); therefore, bald eagles are expected to forage at the selected land. Bald eagles winter in cottonwood-riparian habitats along the Salmon River, and the eagles are expected to occur at the Broken Wing Ranch. Bald eagles are not expected to nest in the MMPO area or at the Garden Creek property due to a lack of suitable habitat, but bald eagles might forage in these areas.

Boreal Owl (Sensitive)

Analysis Areas: MMPO Area

Boreal owls are typically found in mature to old-growth spruce-fir forests in the Rocky Mountains. The owls often nest in abandoned northern flicker (*Colaptes auratus*) and pileated woodpecker cavities in large dead or dying conifers, ponderosa pine, large Douglas-fir, or aspen in mixed conifer, spruce, and Douglas-fir forests (Hayward 1994). Boreal owl roosting and foraging habitat occurs in relatively closed canopy subalpine fir and Engelmann spruce forests (Hayward 1994). Boreal owls may occur in the MMPO area.

Brewer's Sparrow (Sensitive)

Analysis Areas: All

Brewer's sparrows require sagebrush habitat. The sparrows are closely associated with sagebrush shrublands with abundant, scattered shrubs and short grass. The sparrows breed in high densities and tend to be the most abundant bird species where they occur. They build open cup-shaped nests in large sagebrush plants. One study in Idaho found that Brewer's sparrows select taller shrubs ranging from 16 to 41 inches high (Ritter 2000). Brewer's sparrows may occur at the MMPO area, selected land, or Broken Wing Ranch. Brewer's sparrows are not expected to occur at the Garden Creek property due to a lack of suitable habitat.

Calliope Hummingbird (Sensitive)

Analysis Areas: All

Calliope hummingbirds are associated with open coniferous forests, montane meadow-shrublands, riparian thickets of willow and alder, burned areas, and wooded hillsides. The hummingbirds nest in riparian areas and open forests at the edge of meadows. The hummingbirds build nests in trees, usually on a horizontal branch with another branch overhanging, presumably for shelter (Ritter 2000). Calliope hummingbirds may occur in all of the analysis areas.

Flammulated Owl (Sensitive)

Analysis Areas: All

Flammulated owls occur year-round in cool, temperate semi-arid climates, and migrate when necessary to maintain access to their insect prey. The habitat of flammulated owls consists primarily of open ponderosa pine or similar dry montane forests (McCallum 1994). Forests used by flammulated owls include an interspersion of dense thickets for roosting in open, mature to old-growth stands of ponderosa pine, Douglas-fir, or aspen. Flammulated owls are obligate cavity nesters, using natural cavities or (more commonly) old woodpecker holes in large trees and snags (IDFG 2005b). Flammulated owls are likely to occur in the MMPO area and selected land, and may occur at the Garden Creek property. Flammulated owls are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Great Gray Owl (Sensitive)

Analysis Areas: MMPO Area

The primary habitat of the great gray owl in southeastern Idaho is mid- to late-succession Douglas-fir forest (the most abundant habitat available) associated with clear-cut and natural meadows. Great gray owls forage in relatively open, grassy habitat that may include bogs, selective and clear-cut logged areas, natural meadows, or open forests (Duncan and Hayward 1994). Great gray owls may occur in the MMPO area.

Hammond's Flycatcher (Sensitive)

Analysis Areas: All

Hammond's flycatchers are found in coniferous forests (e.g., old-growth Douglas-fir/ponderosa pine in Idaho) and woodlands. During migration the flycatchers can be found in a wider variety of habitats, including deserts and scrubland, and pine and pine/oak associations. Females build cup-shaped nests in trees (coniferous or deciduous) and hunt from a perch (Groves et al. 1997). Hammond's flycatchers may occur at the MMPO area, selected land, or Garden Creek property. Hammond's flycatchers are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Northern Goshawk (Sensitive)

Analysis Areas: All

Northern goshawks are forest generalists, but tend to avoid young, dense forests due to their large size and wingspan. Optimal habitat for northern goshawks includes forest stands with canopy cover greater than 60 percent, overstory trees with diameters greater than 15 inches, and the presence of dead or defective trees greater than 10 inches in diameter. The home range and foraging area varies from 1,235 to 9,884 acres and may be composed of a variety of forest types and openings. Quality foraging habitat is single- or two-storied, non-alpine stands with open or relatively open understories (Samson 2006). Goshawks are not dependent on large, unbroken tracts of old-growth or mature forest (Brewer et al. 2007). Goshawks may occur at the MMPO area, selected land, or the Garden Creek property. Goshawks are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Olive-sided Flycatcher (Sensitive)

Analysis Areas: All

Olive-sided flycatchers are found in forests and woodlands, especially in burned areas with standing dead trees, such as taiga, subalpine coniferous forests, mixed forests, boreal bogs, muskeg, and the borders of lakes and streams. Females build cup-shaped nests in trees (coniferous or deciduous) and hunt from a perch (Groves et al. 1997). Olive-sided flycatchers may occur at the MMPO area, selected land, or Garden Creek property. Olive-sided flycatchers are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Peregrine Falcon (Sensitive)

Analysis Areas: All

Peregrine falcons are adaptable raptors that inhabit mountains, river corridors, marshes, lakes, coastlines, and cites. Peregrine falcons breed on cliffs, cut banks, and in trees. Peregrine falcons do not build stick nests but will use the abandoned nests of hawks, eagles, and ravens. In Idaho peregrine falcons are associated with mountains, major river corridors, reservoirs, and lake basins (IDFG 2005b). A peregrine aerie is present near the mouth of S. Creek. This aerie was occupied in 2008 and 2009 but unoccupied in 2012 (IDFG 2009b, IDFG 2012a). Peregrine falcons may occur or forage at the MMPO area, selected land, or Broken Wing Ranch. Peregrine falcons would not occur at the Garden Creek property due to a lack of suitable nesting habitat, but may use the property for foraging.

Pileated Woodpecker (Sensitive and MIS)

Analysis Areas: MMPO Area

The pileated woodpecker is an uncommon resident species linked to mature Douglas-fir and mixed conifer forest, primarily at mid-elevations. Pileated woodpeckers require large-diameter trees for nesting and roosting. Pileated woodpeckers are not known in the MMPO area, but the woodpeckers were detected in 2005 in the Yankee Fork District (which contains the Forest Service land in the MMPO area) (Table 3.7-3.) (USFS 2006). Therefore, pileated woodpeckers may occur in the MMPO area.

Three-toed Woodpecker (Sensitive)

Analysis Areas: MMPO Area, Garden Creek Property

Three-toed woodpeckers occur in the northern and central parts of Idaho (IDFG 2005b). The woodpeckers usually occupy mature to old forest stands with a high degree of insect and disease activity and numerous snags. The woodpeckers are strongly attracted to infested forests or burned areas (USFS 2009a) because the woodpeckers flake off bark to forage on bark beetles (Koplin 1969), and are thus typically found in forests with high densities of bark beetle larvae (IDFG 2005b). Three-toed woodpeckers may occur in the MMPO area or at the Garden Creek property.

Willow Flycatcher (Sensitive)

Analysis Areas: All

Willow flycatchers breed in riparian habitat with a midstory of willows or alders and an intact lower layer. Shrub thickets interspersed with openings are used more than continuous stands. A dense overstory may discourage use by willow flycatchers. The flycatchers build cup-shaped nests in forks of shrubs or deciduous trees, and are most common at elevations below 5,500 feet (Ritter 2000). Willow flycatchers may occur in all of the analysis areas.

Williamson's Sapsucker (Sensitive)

Analysis Areas: All

Williamson's sapsuckers are found in montane coniferous forests, especially fir and lodgepole pine. The sapsuckers can also be found in lowland forests during migration and winter. The sapsuckers nest in cavities in snags (Groves et al. 1997). Williamson's sapsuckers may occur at the MMPO area, selected land, or Garden Creek property. Williamson's sapsuckers are not expected to occur at the Broken Wing Ranch due to a lack of suitable habitat.

Columbia Spotted Frog (Sensitive and MIS)

Analysis Areas: MMPO Area

Columbia spotted frogs in central Idaho are not part of the Great Basin Distinct Population Segment (candidate for listing under the ESA) that occurs in southwest Idaho. Columbia spotted frogs in central and northern Idaho, including those in the SCNF, are part of a relatively abundant northern population from Alaska to Wyoming (USFWS 2006). The frogs require aquatic habitat components for hibernation (water-flooded burrows), breeding (pooled water), foraging (e.g., shallow pond margins), and migrating between breeding and hibernation sites (corridors containing water and vegetative cover, e.g., wet meadows) (USFWS 2006). The frogs may be found in any suitable riparian or wetland habitat, but are typically found in association with vernal pools. Surveys in 2005 found spotted frog egg masses at six sites in the SCNF Challis-Yankee Fork District (USFS 2006). Columbia spotted frogs may occur in the MMPO area.

Northern Leopard Frog (Sensitive)

Analysis Areas: Garden Creek Property

Northern leopard frogs are associated with marshes, pond margins, and slow-moving sections of streams and rivers. In southern Idaho northern leopard frog populations have been reported in the Snake River and tributaries, including Portneuf River, Bear River, and Marsh Valley. Shive and Peterson (2002) reported the northern leopard frog was the second most abundant species found in their study area in south central Idaho. Northern leopard frogs may occur at the Garden Creek property.

Western Toad (Sensitive)

Analysis Areas: Garden Creek Property

Western toads are found in desert springs and streams, meadows and woodlands, and in and around ponds, lakes, reservoirs and slow-moving rivers and streams. Breeding areas are

typically shallow water at the edges of ponds; the edges of lakes, streams, or rivers with slow-moving water; or other flooded or ponded areas (Keinath and McGee 2005). After breeding, western toads move to more terrestrial habitats and eventually to hibernacula that may be a substantial distance from the breeding site (up to 1.5 miles, but usually much less; Keinath and McGee 2005). Western toads dig a burrow in loose soil or use burrows of small mammals (Groves et al. 1997) and remain in hibernation until the following spring. Western toads may occur at the Garden Creek property.

3.8. Fish and Aquatic Resources

The analysis area for fish and aquatic resources for the MMPO alternatives is the S. Creek and Thompson Creek 6th level HUC watersheds (which include a number of smaller subwatersheds such as Buckskin Creek, Pat Hughes Creek, Cherry Creek, Bruno Creek, etc.), as well as the Salmon River between the mouths of Thompson Creek and S. Creek. The analysis area does not include a specified reach of the Salmon River downstream of S. Creek (e.g., 10 miles downstream). However, the analysis of Salmon River water quality includes inputs from S. Creek and, as a result, effects to fish and aquatic resources in the Salmon River described in Chapter 4 include effects both up and downstream of the mouth of S. Creek. The analysis area for fish and aquatic resources for the land disposal alternatives is the Broken Wing Ranch, the Lyon Creek drainage, and the Garden Creek property. With the exception of the Garden Creek property, all of the aforementioned streams and watersheds are in the Upper Salmon River 5th level watershed (HUC 17060201). The Garden Creek property is in the Portneuf River 5th level watershed (HUC 17040208) (Section 3.6.1.1).

3.8.1. MMPO Area and Selected Land

Thompson Creek, S. Creek, Bruno Creek, and the Salmon River are the primary fish-bearing streams in the analysis area. Fish may also use accessible habitat in some tributaries to Thompson Creek and S. Creek; most of the accessible tributaries are upstream of the mine. Buckskin and Pat Hughes creeks do not provide fish habitat, but would be affected under all of the MMPO alternatives. The hydrologic characteristics of all of these streams were described previously (Section 3.6.1.1).

Near the confluence of S. Creek with the Salmon River, the IDFG in cooperation with TCMC has constructed a steelhead (*Oncorhynchus mykiss*) smolt acclimation and adult trapping facility/pond on S. Creek, referred to as South Butte Pond. The pond receives water via a screened water diversion from S. Creek (IDFG 2004). Release of B-run steelhead smolts into the pond began in 1998. The first return of B-run steelhead adults was in 2002 when 119 adults were collected in the upper Salmon River from fish released at South Butte Pond. Adults have continued to return, e.g., 129 in 2003 and 157 in 2004. Moreover, the total estimated returns of adults (i.e., including the number of adults harvested by sport fisherman) to the upper Salmon River was 1,469 in 2002, 1,813 in 2003, and 1,279 in 2004 (IDFG 2011b). As of 2005, the IDFG estimated that nearly 1,100,000 B-run steelhead smolts had been released from South Butte Pond into lower S. Creek. However, adult fish are collected at South Butte Pond using a temporary weir, which has been problematic due to failure during high water events. As a result, B-run broodstock from S. Creek were transferred to the Pahsimeroi Fish Hatchery in 2009 (IDFG 2012b). The goal is to release up to 280,000 smolts annually to S. Creek. The smolts are currently released directly to S. Creek, and the pond is not being used (IDFG 2011b).

The fish habitat of Bruno Creek is fragmented by the mine, e.g., the TSF fills 2 miles of the stream and there are two sedimentation ponds in lower Bruno Creek. The TSF and associated flow diversions have also affected lower Bruno Creek through decreased streamflow. Regardless, until recently there were isolated fish populations upstream of the TSF, and it appears that fish habitat also remains below the TSF. However, recent surveys above the TSF found no fish present (USFS 2013b). The long-term population viability above the TSF is limited by the lack of gene flow and the inability for fish to re-colonize the reach following events such as floods and drought.

3.8.1.1. Fish Species Present

The analysis area for the MMPO and the selected land provides habitat for six salmonid species, and many native, non-salmonid species that may also be present (Table 3.8-1). The salmonid species exhibit both resident and anadromous life histories and five of the six species are special status species: mountain whitefish [*Prosopium williamsoni*] is the only salmonid not a special status species. Special status fish species are discussed in further detail below, and include those listed as threatened, endangered, proposed, candidate, or sensitive, as well as MIS. Of the native, non-salmonid species that may be present in the analysis area at some point in their life history, sculpin (*Cottus* spp.) are the most common.

Table 3.8-1. Fish species occurrence, MMPO and selected land.

Species	Status	Occurrence
SPECIAL STATUS SPECIES		
Bull trout *Salvelinus Confluentus*	Threatened/MIS	**Present** Bull trout are present in the Salmon River, Thompson Creek, and S. Creek (GEI 2011, IDFG 2004, IDFG 2005b). These streams are designated critical habitat for bull trout.
Chinook salmon *Oncorhynchus tshawytscha*	Threatened/MIS	**Present** Chinook salmon are present in the Salmon River, Thompson Creek, and S. Creek (GEI 2011, IDFG 2004, IDFG 2005b). Only juvenile Chinook salmon have been found in Thompson and S. Creek (no documented adults or redds). All waters presently or historically accessible to Chinook salmon in the Upper Salmon River watershed are designated critical habitat for Chinook salmon. In the analysis area, this includes the Salmon River, Thompson Creek, and S. Creek. Because of the manner in which critical habitat was designated for Chinook salmon (see below), it also would likely include Buckskin Creek, Pat Hughes Creek, and Bruno Creek. However, these streams are unoccupied and would not be occupied for the foreseeable future.

Species	Status	Occurrence
Steelhead/Rainbow trout *Oncorhynchus mykiss*	Threatened (steelhead) MIS/BLM sensitive (rainbow)	**Present** Juvenile steelhead and/or rainbow trout are present in the Salmon River, Thompson Creek, and S. Creek (GEI 2011, IDFG 2004, IDFG 2005b). Only juvenile steelhead/rainbow trout have been found in Thompson Creek (no documented adults or redds). Juvenile steelhead and rainbow trout are indistinguishable based on physical appearance; however, they can be differentiated based on genetics. The Salmon River, Thompson Creek, and S. Creek are designated critical habitat for steelhead.
Sockeye salmon *Oncorhynchus nerka*	Endangered	**Present** Sockeye salmon use the Salmon River for migration to/from central Idaho lakes. The Salmon River is designated critical habitat for Sockeye salmon (BLM 1998).
Westslope cutthroat trout *Oncorhynchus clarkii lewisi*	Forest Service/BLM sensitive/MIS	**Present** Westslope cutthroat trout are present in the Salmon River, Thompson Creek, S. Creek, and Bruno Creek (GEI 2011, IDFG 2004, IDFG 2005b).
NON- SPECIAL STATUS SPECIES		
Bridgelip sucker *Catostomus columbianus*		**Possible** Likely present in the Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
Largescale sucker *Catostomus macrocheilus*		**Possible** May be present in the Salmon River (BLM 1998).
Longnose dace *Rhinichthys cataractae*		**Possible** Likely present in the Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
Mottled sculpin *Cottus bairdii*		**Possible** Sculpin are present in Thompson and S. creeks, and although most of these are identified as shorthead sculpin (GEI 2011), many sculpin are not identified to species (IDFG 2005a, IDFG 2004) and mottled sculpin may also be present. Likely present in the Salmon River (BLM 1998).
Mountain whitefish *Prosopium williamsoni*		**Present** Was historically present in Thompson Creek and is present in S. Creek and the Salmon River (GEI 2011).

Species	Status	Occurrence
Northern pikeminnow *Ptychocheilus oregonensis*		**Possible** May be present in the Salmon River (BLM 1998).
Pacific lamprey *Lampetra tridentata*		**Possible** Precise distribution data for Pacific lamprey is unavailable for much of the upper Salmon River; however, lamprey once migrated into all Idaho waters that salmon and steelhead migrated into (Simpson and Wallace 1982). Lamprey have been found ~ 90 miles downstream of the analysis area (Curet 2013).
Redside shiner *Richardsonius balteatus*		**Possible** Likely present in the Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
Shorthead sculpin *Cottus confusus*		**Present** Present in the Salmon River, Thompson Creek, and S. Creek (BLM 1998, GEI 2011).
Speckled dace *Rhinichthys osculus*		**Possible** Likely present in the main Salmon River and may be present in some tributaries (BLM 1998, IDFG 2010b).
White sturgeon *Acipenser transmontanus*		**Not Present** The Snake River population of white sturgeon occurs in the Snake River and the mainstem Salmon River. They are rarely seen above the North Fork Salmon River (~ 100 miles downstream of the analysis area) (IDFG 2005a).

Special Status Species

There are four fish species listed as threatened or endangered that use components of the analysis area for a portion of their life history: bull trout, Chinook salmon, sockeye salmon, and steelhead (Table 3.8-1). In addition, westslope cutthroat trout and resident rainbow trout are also present in the analysis area. Westslope cutthroat trout are a MIS and a Forest Service and BLM sensitive species.

The analysis area also contains designated critical habitat for bull trout, sockeye salmon, Chinook salmon, and steelhead. The USFWS oversees recovery efforts and critical habitat for resident fish species (e.g., bull trout) and the NMFS oversees recovery efforts and critical habitat for anadromous fish species (e.g., salmon, steelhead). The ESA defines species to include distinct population segments (DPS). Three elements are considered in the designation of a DPS (61 FR 4722): 1) discreteness of the population segment in relation to the remainder of the

species to which it belongs; 2) the significance of the population segment to the species to which the segment belongs; and 3) the population segment's conservation status in relation to the ESA standards for listing.

For Pacific salmon, the NMFS has established evolutionary significant units (ESUs) as the listing unit for salmon. Under this policy, a population is considered a DPS if it represents an ESU (61 FR 4722). An ESU is a population or group of populations that is substantially reproductively isolated from other populations of the same species and represents an important component in the evolutionary legacy of the species (61 FR 4722, NMFS 1999). As steelhead may come under the jurisdiction of both the USFWS (for resident rainbow trout) and NMFS (anadromous steelhead), steelhead are listed as DPSs (71 FR 834).

In addition to being designated critical habitat, streams in the analysis area are essential fish habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (16 USC 1801 *et seq.*): "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 USC 1802). The habitat is designated on a watershed scale and includes all currently viable waters and most of the habitat historically accessible to salmon in a specified USGS hydrologic unit (PFMC 1999). All waters designated critical habitat for Chinook salmon in the Upper Salmon River subbasin (HUC 17060201) are also EFH.

Bull Trout and Designated Critical Habitat

Bull trout exhibit a variety of life history traits, including migratory and resident forms. Migratory forms can be anadromous near coastal areas, or more commonly, fluvial, and adfluvial migrant forms. Fluvial and adfluvial adults reside in large rivers and lakes, returning to headwater tributaries to spawn. The offspring rear in the headwater streams for 1 to 4 years before migrating to larger rivers or lakes. Resident bull trout have adapted to reside their entire life in the headwater streams. Habitat requirements for bull trout appear to be very specific, including cold, clean water for spawning and complex habitat, with a large amount of large woody debris (LWD) being especially important. As a result of the reliance on cold, clean water bull trout primarily spawn in upper elevation streams.

In the Upper Salmon River drainage, bull trout move into natal tributaries beginning in August and spawn in mid- to late September and October (BLM 2011). Eggs may hatch in winter or early spring, with alevin (sac fry) remaining in the gravel until spring (April). Once the juveniles fully emerge, they inhabit side channels and other low velocity habitat.

The USFWS draft bull trout recovery plan (USFWS 2002) initially subdivided bull trout distribution in Idaho into seven recovery units including the Salmon River Recovery Unit, of which the Upper Salmon River Core Area was a subset. The USFWS subsequently issued a final rule designating critical habitat for bull trout in 2010 (75 FR 63898). In the Final Rule, the USFWS identified six draft recovery units that replaced earlier recovery units. The analysis area is in the Upper Snake Recovery Unit. In the recovery units, there are 32 designated critical habitat sub-units, with the analysis area in the Upper Salmon River critical habitat subunit (CHSU). In the analysis area, the Salmon River, Thompson Creek, and S. Creek are all designated critical habitat for bull trout. Critical habitat provides features considered essential to

the conservation of the species. The Upper Salmon River CHSU has been determined to be critical habitat essential to bull trout conservation because the river provides a rare fluvial life history expression in the Upper Snake Recovery Unit. The river contains many individuals, a large amount of habitat, and few threats. The CHSU contains populations with fluvial life history expressions that are important in the long-term recovery of the species (USFWS 2009).

Chinook Salmon, Designated Critical Habitat, and EFH

Spring/summer Chinook salmon in the Snake River drainage form a distinct ESU, which includes all naturally spawning populations in the Salmon River subbasin (57 FR 23458). Snake River spring/summer Chinook salmon enter the Columbia River from February through March, arriving at natal tributaries from June through August, then hold in deep mainstem and tributary pools until late summer when the fish spawn (Good et al. 2005, NMFS 2011). Spring-run Chinook salmon spawn in mid- to late August, with summer-run Chinook salmon spawning approximately 1 month later (Good et al. 2005). Chinook salmon present in the analysis area are primarily summer-run fish and are part of the Upper Salmon major population group (MPG) (NMFS 2011).

Spring/summer Chinook salmon in the Snake River drainage have a stream-type life history. After spawning in late summer or early fall, eggs incubate overwinter and hatch in later winter/early spring of the following year. As described for bull trout, alevins remain in the gravel for approximately 4 to 6 weeks after the embryos hatch, with juveniles emerging during the spring. Juveniles then rear throughout the summer, overwinter, and migrate to the ocean in the spring of their second year (Good et al. 2005). Spring/summer Chinook salmon use the Salmon River as a migration corridor to access tributary spawning habitats. Chinook salmon also use the Salmon River for spawning and rearing. It is uncertain if Chinook salmon spawning occurs in the primary tributary streams in the analysis area, including Thompson Creek, S. Creek, and Lyon Creek (offered land). However, juvenile individuals have been documented to occur in the aforementioned streams.

The NMFS designated all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon as critical habitat in 1993 (58 FR 68543), with a revision in 1999 (64 FR 57399). In the Upper Salmon River watershed, this includes the Salmon River, Thompson Creek, S. Creek, and Lyon Creek (offered land). Although fish habitat in Buckskin Creek, Pat Hughes Creek, and Bruno Creek was largely eliminated prior to designation of critical habitat, the critical habitat designation only explicitly excludes those areas blocked by impassable natural falls and Hells Canyon Dam. In addition, although Buckskin Creek and Pat Hughes Creek may have been intermittent historically (which would have resulted in dry, impassable reaches during portions of the year), the critical habitat designation rule implies that intermittent streams are included (58 FR 68547, EPA 2006). As a result, Buckskin, Pat Hughes, and Bruno creeks are considered designated critical habitat although they are currently not occupied by Chinook salmon and could not be occupied in the future due to barriers (sediment ponds) in the lower reaches and the WRSFs and TSF in the upper reaches. Streams in the analysis area that are freshwater EFH (Salmon River, Thompson Creek, S. Creek, and Lyon Creek) are defined as those waters and substrate necessary for spawning, breeding, feeding, or growth to maturity (50 CFR 600 Subpart K).

Sockeye Salmon and Designated Critical Habitat

Sockeye salmon differ from other Pacific salmon species in that sockeye salmon generally spawn in freshwater lakes and inlet or outlet streams to these same lakes. The Snake River sockeye salmon ESU that spawns in mountain lakes of central Idaho were listed as endangered in 2001 (57 FR 212). Adult Snake River sockeye salmon use the Snake and Salmon rivers as migration corridors to spawn in Redfish Lake and other central Idaho lakes. Smolts from Redfish Lake (and from the Sawtooth Fish Hatchery captive broodstock program) also use the Salmon River as a migration corridor for their outmigration. Snake River sockeye salmon do not use habitat in the analysis area for any other life stages. Critical habitat for Snake River sockeye salmon was designated in 1993 (58 FR 68543). The designation includes the Salmon River from Alturas Lake Creek to the confluence of the Salmon River with the Snake River. The analysis area includes 4.4 miles of designated critical habitat for Snake River sockeye salmon along the Salmon River.

Steelhead/Rainbow Trout and Designated Critical Habitat

Steelhead are anadromous rainbow trout. Rainbow trout life history can be complex as they can be anadromous (steelhead) or freshwater resident (rainbow or redband trout) and can yield offspring of the opposite form (Good et al. 2005). Juvenile steelhead are indistinguishable from resident rainbow trout based on physical appearance (some may be differentiated based on genetics). The Snake River steelhead DPS includes all naturally spawned populations of steelhead in the Snake River and its tributaries (including the Salmon River and its tributaries). Steelhead were originally listed as threatened in 1997 (62 FR 43937). However, the original listing for the Snake River steelhead ESU included anadromous steelhead and resident, non-anadromous rainbow trout. The revised listing for the Snake River steelhead DPS as threatened does not include rainbow trout, which are under the jurisdiction of the USFWS (71 FR 834). Steelhead in the analysis area are in the Salmon River MPG (NMFS 2011).

As with salmon, multiple life histories exist for steelhead. Steelhead in the analysis area are primarily summer run steelhead. Summer run steelhead adults enter freshwater in a sexually immature condition between May and October and require several months to mature and spawn. After holding over the winter, adult summer-run steelhead spawn the following spring (March to May) over clean gravel. Juveniles typically emerge by early June or mid-July (NMFS 2011) and rear for 1 to 3 years in freshwater before beginning the smoltification process. Steelhead smolts will typically migrate to the ocean in April through July.

Snake River summer steelhead are divided into two groups: A-run and B-run. Steelhead returning to the Salmon River are considered to be primarily A-run steelhead, which are predominantly age-1 ocean fish. Steelhead use the Salmon River as a migration corridor to access tributary spawning and rearing habitat. However, steelhead also use the Salmon river for spawning and rearing. In addition, the IDFG hatchery program (under the Lower Snake River Compensation Program) has worked to establish a B-run steelhead fishery in the upper Salmon River, which has included releases in S. Creek and South Butte Pond (IDFG 2012b) (Section 3.8.1). Critical habitat for steelhead was initially designated in 1999 (59 FR 54840), with a final designation in 2005 (70 FR 52630). Designated critical habitat in the analysis area includes all waters of the Upper Salmon River watershed, including the Salmon River, Thompson Creek, and S. Creek.

Westslope Cutthroat Trout

Westslope cutthroat trout feed primarily on aquatic macroinvertebrate organisms and are not highly piscivorous (i.e., do not have a diet of primarily fish) like other cutthroat trout subspecies (Behnke 1992). Westslope cutthroat trout reach maturity at 4 to 5 years of age and spawn primarily in small tributary streams between March and July. Early life history (i.e., embryo, alevin, swim-up) is similar to what is described for steelhead/rainbow trout. Fry may grow to maturity in the spawning streams or may move downstream into larger rivers. Similar to bull trout, adults may be resident or fluvial migrant fish (Behnke 1992).

3.8.1.2. Acid Rock Drainage Effects to Fish

Metals released from ARD become readily available to biological organisms. For example, in water when fish are exposed directly to metals and acid through the gills, impaired respiration may result from chronic and acute toxicity. Fish are also exposed indirectly to metals through ingestion of contaminated sediment and food items. Water with pH 2.0 to pH 4.5 is acutely toxic to most aquatic life. Most fish species are not affected by water with pH 5.5 to pH 10.0 (RRG 2008). Background information more relevant to metal toxicity to fish for the MMPO alternatives is presented in Section 4.8.1.

3.8.1.3. Aquatic Habitat

Various BLM, Forest Service, IDFG, and TCMC surveys, water quality monitoring sites, and biological monitoring sites have been established in the analysis area (Section 3.6.1.1., Figure 3.8-1). The baseline conditions for aquatic habitat in the analysis area are described using data from these surveys and monitoring.

JBR (2014f) describes the baseline conditions of aquatic habitat in the MMPO area and the selected land relative to the NMFS indicators of properly functioning condition (PFC) and standards for future desired conditions matrix (NMFS 1996) and the associated USFWS matrix for bull trout (USFWS 1998). Both the NMFS matrix and the USFWS matrix are used since anadromous fish such as steelhead and Chinook salmon are under NMFS jurisdiction, whereas non anadromous bull trout are under the jurisdiction of the USFWS. JBR (2014f) also analyzes effects that might occur relative to the NMFS and USFWS indicators under the MMPO alternatives. The analysis in JBR (2014f) described effects that would be confined to habitat removal (Buckskin and Pat Hughes creeks), small changes in water quantity, and changes in water quality. Therefore, the discussion of baseline aquatic habitat conditions in this section focuses on stream disturbance, flow, and water quality. This discussion corresponds to the NMFS and USFWS indicators for disturbance history, riparian reserves, sediment/turbidity, chemical contaminants and nutrients, and peak/base flows. Additional detail regarding chemical contaminants and nutrients, and peak/base flows is provided in Section 3.6.1.1. (NMFS 1996, USFWS 1998).

As the discussion of baseline condition includes assigning a condition level to each indicator discussed using NMFS (1996) and USFWS (1998) guidelines, the terms used are described below. For each indicator (e.g., disturbance history, riparian reserves, sediment/turbidity, chemical contaminants and nutrients, and peak/base flows) a condition is assigned one of three NMFS or USFWS condition levels. The NMFS condition levels are *properly functioning*,

functioning at risk, and *not properly functioning*. The USFWS condition levels are *functioning appropriately*, *functioning at risk*, and *functioning at unacceptable risk*. These are terms specified in NMFS (1996) and USFWS (1998) and are not an analysis of effects, but only terms used to rate the baseline condition.

Thompson Creek Watershed

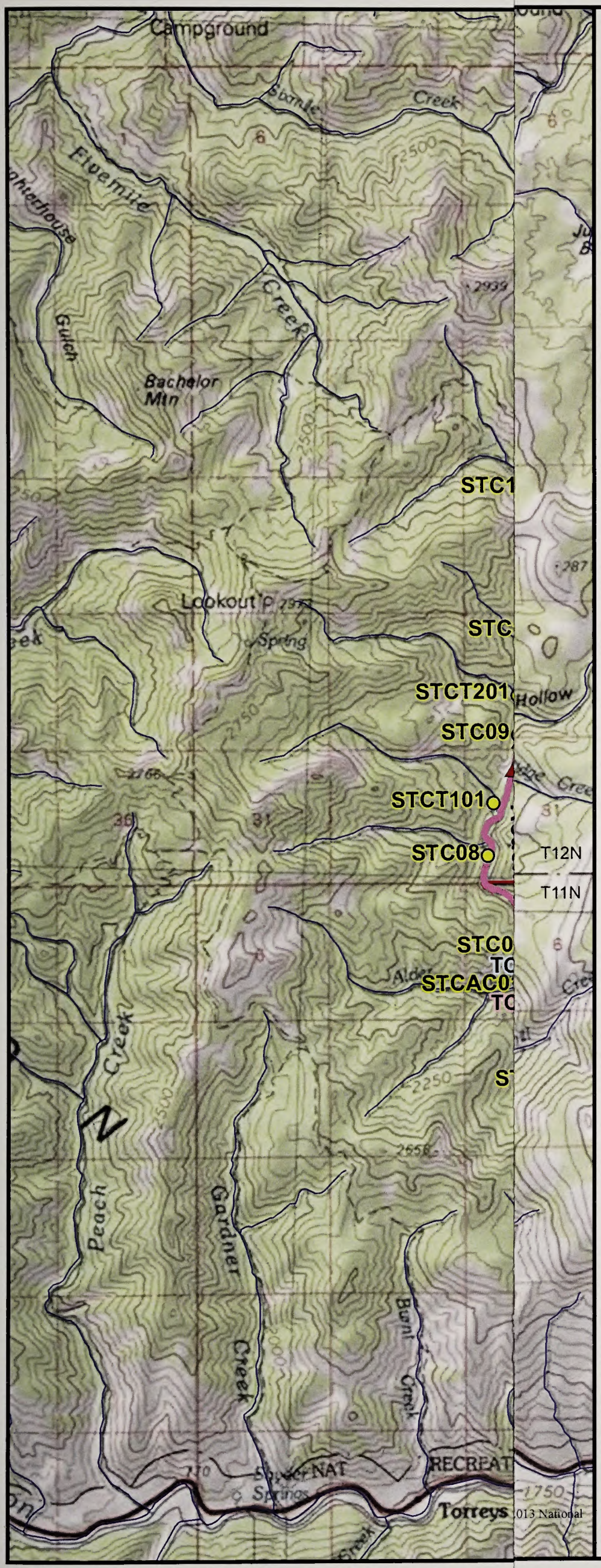
Water Quality

Sediment and Turbidity

The NMFS guidelines for sediment/turbidity suggest a guideline for the percentage of fine sediment in gravel (< 12 %) for properly functioning condition; USFWS suggest a guideline for fine sediment in gravel (< 12 %) as well as for surface fines (< 20 %). As a result, data from core sampling (percentage fine sediment in gravel) and visual estimates (surface fines) are used to analyze baseline condition. Percentage fine sediment in gravel at TC4 and TC1 has been greater than 12 percent in approximately half the core samples taken during 1996 to 2010. The results of core sampling indicate that the mean percentage of fine sediment at the sites during 1996 to 2010 was 11.0 percent at TC4 (upstream of Buckskin Creek and all surface water discharge from the mine) and 12.5 percent at TC1 (EnviroNet 2011). In the last year of the period of record analyzed (2010), the percentage of fine sediment was greater than 12 percent at both sites (12.4 % at TC4, 12.5 % at TC1).

However, the percentage of fine sediment has been less than 12 percent in many years and the mean percentage is below 12 percent at TC4 during 1996 to 2010. There is no statistically significant difference in the percentage of fine sediment between background and sites downstream of mine facilities.

In addition, the percentage of surface fine sediment in Thompson Creek has typically been low. The mean percentages of fine sediment (particles < 6 mm in diameter; 1 mm ≈ 0.04 inch) in the R1/R4 survey reaches in 2002 were 16.6, 15.4, 11.5, and 11.8 percent for reaches one, two, three, and four, respectively (Figure 3.8-1). At TC4 and TC1, the mean percentage of surface fine sediment has typically been less than 7 percent in both reaches, with a mean percentage of 5.6 and 7.5 percent during 1996 to 2009 for TC4 and TC1, respectively. However, surface fine sediment at the TCMC monitoring sites has been defined as particles less than 4.8 mm in diameter, rather than 6 mm in diameter. Regardless, the monitoring (and the assessments conducted during the R1/R4 survey in 2002) are conducted visually, and distinguishing between such small size differences (~ 1 mm) visually through moving water is relatively difficult. As a result, the two sets of data (and the TCMC data to the NMFS and USFS guideline of 6 mm) should be comparable (Markham 2007). With low percentages of surface fine sediment (< 20 % from all data considered, and typically much lower) and the percentages of fine sediment in gravel fluctuating around 12 percent, the baseline condition for sediment and turbidity is *properly functioning/functioning appropriately*. In addition, turbidity is generally low based on TCMC monthly turbidity records from January 1999 to December 2010 (Section 3.6.1.1).



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- Selected land
- Biological monitoring sites
- Water quality monitoring sites
- IDFG Transect start locations
- 1992 Forest Service R1/R4 survey
- 2002 Forest Service R1/R4 surveys reaches
- 2009 TCMC R1/R4 surveys reaches

N

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0 6,000 Feet

0 2 Kilometers

Data source Lorax 2011e
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Water quality and biological monitoring sites from TCM
Reach surveys from TCM and Forest Service
IDFG Transects from unpublish reports from Idaho Department of Fish and Game
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.8-1
Survey and monitoring locations, MMPO area and selected land
Thompson Creek Mine EIS

functioning at risk, and *not properly functioning*. The USFWS condition levels are *functioning appropriately*, *functioning at risk*, and *functioning at unacceptable risk*. These are terms specified in NMFS (1996) and USFWS (1998) and are not an analysis of effects, but only terms used to rate the baseline condition.

Thompson Creek Watershed

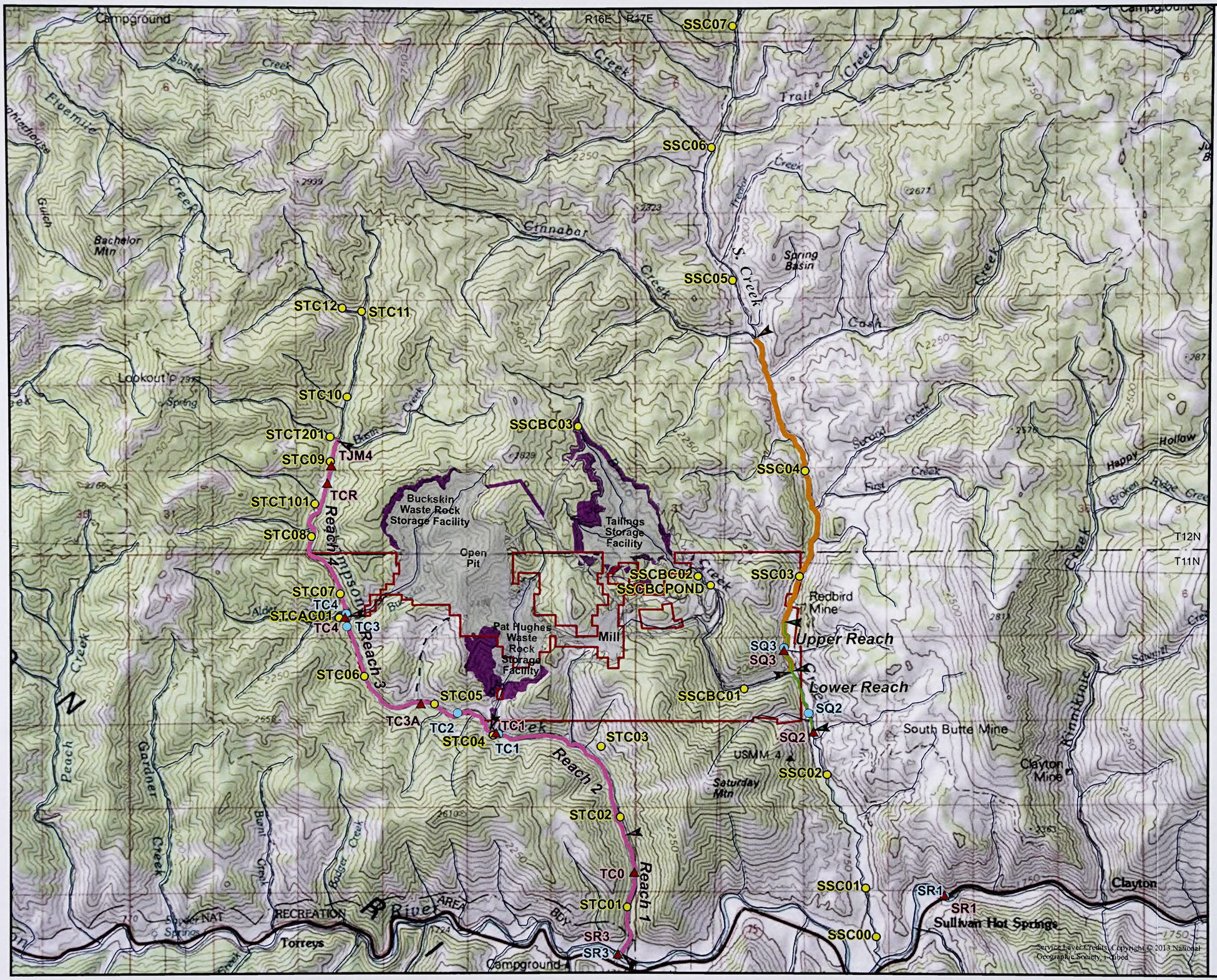
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Legend

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Data source Lorax 2011e
Aerial image 2009 NAIP background
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
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Coordinate system UTM Zone 11 NAD 83

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Figure 3.8-1
Survey and monitoring locations, MMPO area and selected land
Thompson Creek Mine EIS

Chemical Contamination and Nutrients

Water at TC4 (upstream of Buckskin Creek and all surface water discharge from the mine site) has good quality. Molybdenum is present at concentrations above the laboratory detection limit, whereas the concentrations of other trace metals are typically below the laboratory detection limit. The concentration of molybdenum varies seasonally but is naturally occurring in detectable concentrations in Thompson Creek because it naturally contains relatively high concentrations of molybdenum in the stream sediment (e.g., the first indications of the ore deposit during mineral exploration in the region were elevated concentrations of molybdenum in Pat Hughes Creek, Schmidt 1991). The water quality of Thompson Creek decreases downstream of the mouth of Buckskin Creek, particularly at TC3, between the mouths of Buckskin and Pat Hughes creeks. For example, at TC3 the TDS, conductivity, hardness, and the concentrations of sulfate, nitrate, barium, molybdenum, and selenium are all greater than that of background concentrations (TC4) (the pH is the same). The concentrations of other elements, such as copper, which is discussed further in Section 4.6.1.2., are not greater than that of background concentrations (Section 3.6).

Of these constituents, only the concentration of selenium has exceeded WQSs. Due to past difficulty in meeting WQSs and the potential for bioaccumulation of selenium in the food chain, selenium is one of the primary chemicals of potential concern for fisheries resources. Selenium in samples from TC3 equaled or exceeded the CCC standard for aquatic life of 5 µg/L during low flow during 2000 to 2004. Water from Buckskin Creek has not been discharged since 2005 to Thompson Creek when its streamflow is less than 7 cfs as measured at the USGS gage, and since 2005 the concentration of selenium at TC3 has never exceeded the CCC of 5 µg/L. From 2005 to 2010, concentrations of selenium of 5 µg/L were present in water sampled in August 2006, October 2006, and October 2009; the selenium concentration in all other samples was between 2 µg/L and 4 µg/L at TC3. The monitoring sites in Thompson Creek are sampled year-round (not just during base flow). However, during periods of higher flow there is greater dilution and the concentrations of selenium are lower than described above, and no CCC exceedances have occurred. However, even when WQSs are met, there is the potential for bioaccumulation of chemicals in fish, particularly selenium.

Studies show that selenium bioaccumulates in fish primarily via ingestion (Hamilton 2004, Hamilton et al. 2004). Invertebrates and plants concentrate dissolved selenium from the water, and this selenium can then be part of the food base for fish feeding in contaminated reaches of streams (Chapman 2007, Hamilton et al. 2004). The eventual location of such selenium may be in the stream sediment where the selenium may be perennially available for bioaccumulation in plants, benthic invertebrates, and fish, even though the concentrations of selenium in the water may seasonally be less than aquatic life toxicity thresholds for the concentration of selenium in water (Hamilton 2004). Excessive bioaccumulation of selenium in fish can result in larval developmental abnormalities and mortality (Holm et al. 2005).

The bioaccumulation of selenium in Thompson Creek was assessed during 2000 to 2004 to satisfy requirements in the NPDES permit for the mine. The concentrations of selenium in sediment, fine particulate organic matter (FPOM), macroinvertebrate organisms, and fish tissues were assessed from four sites on Thompson Creek, two upstream (TCR and TC4) of mine

disturbance and two downstream (TC3A and TC1) (Chadwick 2005). Sites TC2 and TJM4 were not sampled as part of the bioaccumulation assessment. The concentrations of selenium in sediment were below detection limits in 2004 at all of the sampled sites, but were higher in previous years. Selenium was present in macroinvertebrate organisms and fish at all four sites in 2004, including the upstream sites, demonstrating bioaccumulation of selenium in the food chain (Chadwick 2005). This was true for previous years as well. The concentration of selenium in macroinvertebrate organisms and sculpin was statistically higher in 2004 at TC1 and TC3A (downstream of mine discharge) and TC4 (just upstream of mine discharge) than at the furthest upstream site (unaffected by mine discharge) (Table 3.8-2).

Table 3.8-2. Mean concentrations of selenium.

Site	Year	Mean Concentration (mg/kg dry weight)				
		Sediment	FPOM	Macroinvertebrate Organisms	Sculpin	Rainbow/Cutthroat Trout
TCR	2000	NS	NS	NS	NS	NS
	2001	NS	NS	NS	NS	NS
	2002	0.20	4.53	2.01	3.22	2.39
	2003	0.26	2.60	1.66	6.21	3.97
	2004	< 0.84	< 0.6	2.69	6.01	6.37
TC4	2000	0.70[1]	NS	10.13	8.98	7.12
	2001	0.70[2]	NS	8.62	10.00	6.46
	2002	0.70	4.48	4.74	6.81	3.61
	2003	0.48	2.90	5.13	10.34	6.44
	2004	< 0.91	< 0.6	7.45	10.74	7.65
TC3A	2000	NS	NS	NS	NS	NS
	2001	NS	NS	NS	NS	NS
	2002	1.00	5.68	7.14	8.39	4.10
	2003	1.06	5.20	6.69	9.29	6.57
	2004	< 0.89	1.9	6.72	8.70	7.80
TC1	2000	0.70[1]	NS	8.83	7.85	7.87
	2001	2.30[2]	NS	5.19	9.98	8.03
	2002	1.80	8.44	3.57	7.55	4.49
	2003	0.55	5.90	7.72	9.93	6.50
	2004	< 0.95	6.7	7.25	10.18	7.71

NS – Samples were not collected at TCR or TC3A in 2000 or 2001. Sites TC2 and TJM4 were not sampled as part of the bioaccumulation assessment.

[1] Value is from a single sample and is not a mean of multiple samples

[2] Estimated value due to matrix interferences during laboratory analysis

Chadwick (2002, 2003a, 2004, and 2005)

The concentrations of selenium in macroinvertebrate organisms in all years were below the dietary selenium threshold of 11 mg/kg (dry weight) for coldwater fish recommended by DeForest et al. (1999) and used by Chadwick (2003b, 2005). Furthermore, Chadwick (2003b,

2005) determined that the concentration of selenium in all years for sculpin and trout was below an effects level of 11.6 mg/kg derived from the literature (e.g., EPA 2002). However, the EPA has subsequently released draft aquatic life water quality criteria for selenium (EPA 2004) that discusses similar effects levels for salmonids as those used by Chadwick (2005), but proposes a national standard of 7.91 mg/kg (dry weight). The mean concentrations of selenium in 2004 from sculpin from TC4, TC3A, and TC1 would exceed the new proposed criterion, as would the mean concentrations of selenium in 2000, 2001, and 2003. The concentrations of selenium in trout were less than the proposed criterion at each site and in each year, except in 2001 at the most downstream site (TC1). Ongoing biological monitoring on Thompson Creek shows macroinvertebrate, sculpin, and trout populations have not declined due to the mine (GEI 2011) (Section 3.8.1.4). Based on the biological monitoring, Chadwick (2005) concluded that the existing concentrations of selenium in Thompson Creek do not pose a threat to the aquatic community.

The most recent IR considers Thompson Creek as fully supporting its designated cold water aquatic life, salmonid spawning, and secondary contact recreation beneficial uses (IDEQ 2011a). In addition, changes in water management at the mine since 2005 have improved the water quality of Thompson Creek, particularly regarding selenium. The changes have also probably led to decreased selenium bioaccumulation, but data on bioaccumulation since the changes are not publicly available. Furthermore, in the approved mixing zones downstream of Buckskin and Pat Hughes creeks, the concentrations of certain constituents are allowed to be greater than the WQSs. Mixing zones as they relate to the NPDES permit and the effects to special status species are described in detail in EPA (2000). Even though there are no 303d listings, there is the possibility for effects from the mixing zones and selenium concentrations in biota (such as sculpin) that may exceed the proposed national standard of 7.91 mg/kg (Table 3.7-3., based on the 2004 data, the last year of data available). As a result, the more conservative baseline condition for chemical contaminants and nutrients is *functioning at risk*.

Peak/Base Flows

Due to diversions of Buckskin and Pat Hughes creeks, the base flow in Thompson Creek is approximately 10 percent lower than prior to mine activity (Section 3.6.1.1). In addition, peak flows following precipitation events are less pronounced due to permeability of the WRSFs. The IDFG considers the low summer base flows to be a limiting factor for fish populations in Thompson Creek (IDFG 2005a). Therefore, the baseline condition for peak/base flows is *functioning at risk*.

Disturbance History

The primary disturbance in the Thompson Creek watershed is the TCM on 1,824 acres of the watershed. The mine covers 9.5 percent of the watershed, which is below the 15 percent equivalent clear-cut area (ECA) specified in NMFS (1996) and USFWS (1998) for *properly functioning/functioning appropriately*. Although the mine disturbance is stable, a portion of the disturbance includes portions of streams and riparian areas in the Buckskin and Pat Hughes subwatersheds. Much of the streams and associated riparian vegetation in these two subwatersheds are buried by waste rock and no longer function as natural streams, with flow captured and diverted to the mine during parts of the year. Although sediment control ponds

collect sediment from disturbance, disturbance has heavily altered the function of these tributaries, and the baseline condition for disturbance history is *functioning at risk*.

Riparian Reserves

The riparian condition along Thompson Creek is generally good, with intact vegetation along approximately 90 percent of the streambank (no vegetation was present along 11.5, 8.4, 3.5, and 12.4 % of the streambank in reaches 1 through 4 in 2002). The dominant vegetation is willow, alder, and wetland forbs and grasses (USFS 2002). However, riparian vegetation is less intact in the small tributary drainages affected by the mine (i.e., Buckskin, Pat Hughes) and the baseline condition for riparian reserves is *functioning at risk*.

S. Creek Watershed

Water Quality

Sediment and Turbidity

As described for Thompson Creek, guidelines for both the percentage of fine sediment in gravel and for surface fines are considered. The results of core sampling indicate that the mean percentage of fine sediment in gravel substrate at SQ2 and SQ3 during 1996 to 2010 were 14.7 and 15.0 percent, respectively. The percentages were greater than the guideline in 11 (SQ2) and 10 (SQ3) of the 16 sample events. The percentages of fine sediment in gravel in the last year of the data analyzed (2010) were 12.7 and 17.5 percent at SQ2 and SQ3, respectively. Statistical analysis, comparing the data from each year between 1996 and 2010, shows that the amount of fine sediment was higher at the upstream site in 2010 than in 2009. However, there was no statistically significant difference between years at the downstream site or among all previous years combined and 2010 (EnviroNet 2011).

Similar to Thompson Creek, the percentages of surface fine sediment have generally been below 12 percent, with mean percentages of 5.2 percent (SQ2) and 6.1 percent (SQ3) during 1996 to 2010. The percentages of surface fine sediment from the R1/R4 reaches in 2009 were 10.0 and 9.7 percent for the upstream and downstream reaches, respectively. Although the percentages of surface fine sediment are generally low, the percentages are higher than the 12 percent recommended level in substrate core samples in many years. However, the percentages of surface fine sediment have also been below the NMFS and USFWS guideline in some years, and sediment in S. Creek may be close to a properly functioning/functioning appropriately condition. The BLM (2011) also noted that the percentages of surface fine sediment were low on BLM portions of S. Creek and that substrate may be functioning appropriately. However, the average percentage of fine sediment in gravel substrate from Forest Service core sampling just above the BLM/Forest Service boundary (just upstream of where Redbird Creek enters S. Creek) during 1995 to 2004 and 2007 to 2008 was 27.8 percent (BLM 2011). Given that the Forest Service and TCMC core sampling data shows a tendency for higher than the 12 percent recommended level of fine sediment in S. Creek, the more conservative baseline condition for sediment and turbidity is *functioning at risk*, which was the same conclusion reached by the BLM (2011). However, the relatively high percentages of fine sediment are probably due in large part to natural conditions, e.g., numerous active and remnant beaver dams on S. Creek (BLM 2011). Because of this

beaver activity, the TCMC monitoring sites have needed to be relocated several times over the years.

Chemical Contamination and Nutrients

The concentrations of the constituents measured at SQ2 and SQ3 (Figure 3.8-1.) were within all the WQSs. However, between 2008 and 2010, the mean concentrations of sulfate were greater (43.5 mg/L to 59.8 mg/L) at the upstream site (SQ3) than they were during 2000 to 2007 (Table 3.6-9. and Table 3.6-10). Furthermore, the median concentrations of sulfate, chloride, and molybdenum during 2000 to 2010 were approximately 5 mg/L, 1.1 mg/L, and 0.00039 mg/L higher, respectively, downstream of the mouth of Bruno Creek (SQ2) than upstream (SQ3), indicating an input of mine-affected water between the two sites (Table 3.6-9. and Table 3.6-10.; JBR 2014g). Additionally, the median concentration of dissolved barium was 0.001 mg/L higher at SQ2 than at SQ3 (Table 3.6-9. and Table 3.6-10). The TSS is generally less than 10 mg/L, with a high of 43 mg/L at SQ3 and 53 mg/L at SQ2.

Water from the abandoned Twin Apex mine (which flows into lower Bruno Creek) may contribute to the concentrations of metals at SQ2. However, overall Bruno Creek contributes a relatively small load of metals to S. Creek (Section 3.6.1.1). The effect of Redbird Creek on S. Creek as a result of mine-related loading of chemical contaminants to Redbird Creek has not been determined because the historic upstream monitoring site on S. Creek used for this analysis is downstream of Redbird Creek. An additional monitoring site (SQ5) upstream of Redbird Creek was established in August 2011 to provide better background information in the future. However, the concentrations of chemicals of potential concern measured in samples from the monitoring site in lower Redbird Creek are all well below the WQSs. Therefore, there may not be any meaningful effects to aquatic life in S. Creek from water from Redbird Creek.

The WQSs list cold water aquatic life, salmonid spawning, and secondary contact recreation designated beneficial uses for S. Creek. The portion of S. Creek from Redbird Creek to the confluence of S. Creek with the Salmon River fully supports the designated beneficial use for S. Creek of cold water aquatic life. Salmonid spawning and secondary contact recreation were not assessed (IDEQ 2011a). Therefore, because the WQSs are met, the beneficial use is fully supported, and there are no chemicals of concern for bioaccumulation, the baseline condition for chemical contaminants and nutrients in S. Creek is *properly functioning/ functioning appropriately*.

Peak/Base Flows

Streamflow in lower S. Creek is reduced by the effects of the mine to Bruno Creek (Section 3.6.1.) and by substantial water diversions from S. Creek for agriculture. The baseline condition for peak/base flows is *functioning at risk*.

Disturbance History

The primary disturbance in the Lower S. Creek watershed is the TSF covering 992 acres (8.2 %) of the watershed, which is below the 15 percent ECA specified for *properly functioning/functioning appropriately*. However, a large portion of the disturbance includes filling riparian areas along Bruno Creek. As a result, the baseline condition for disturbance history is *functioning at risk*.

Riparian Reserves

The riparian condition along S. Creek is generally good with intact vegetation along approximately all of the streambank. The most dominant vegetation is willow, alder, and wetland forbs and grasses (GEI 2009). However, the TSF permanently covered riparian vegetation along Bruno Creek, and hence the baseline condition for riparian reserves, is *functioning at risk.*

Salmon River Watershed

Water Quality

The mine is 3 miles north of the Salmon River, so effects from the MMPO and land disposal alternatives would be limited to changes in water quality and quantity. Water quality may be affected from 1) flows from Thompson Creek and S. Creek (as currently occurs), and 2) discharge of mine water from Outfall 005 on the Salmon River (after reclamation). Outfall 005, the end of a pipeline between the Salmon River and the mine, does not currently discharge mine water to the Salmon River (rather, it is currently the intake for water pumped to the mine for use in the mill), but will discharge water following reclamation.

Temperature/Sediment and Turbidity

Data on temperature, sediment, and turbidity for the Salmon River is not as extensive as for Thompson Creek and S. Creek. However, between the mouths of Thompson and S. creeks the Salmon River is 303(d)-listed for not supporting the cold water aquatic life beneficial use due to sedimentation/siltation and water temperature. The IDEQ has proposed delisting this portion of the river for sediment and temperature, pending the assessment of additional sediment and temperature data. Due to the 303(d) listing of the Salmon River between the mouths of Thompson and S. creeks, the baseline condition for the Salmon River for water temperature and sediment and turbidity is *functioning at risk.* However, the condition would likely change to *properly functioning/functioning appropriately* if the listing were revised as explained above.

Chemical Contamination and Nutrients

Of the measured constituents, only the concentrations of sulfate and barium have slightly higher median concentrations during 2007 to 2010 at the downstream Salmon River site (SR1) (2 mg/L) than at the upstream reference site (SR3) (0.0012 mg/L). Water at both of the sites meets all WQSs. Designated beneficial uses for the Salmon River downstream of the mouth of Thompson Creek include cold water aquatic life, salmonid spawning, primary contact recreation, and domestic water supply. The Salmon River downstream of the mouth of S. Creek fully supports the designed beneficial uses of cold water aquatic life and primary contact recreation; support for salmonid spawning uses was not assessed (IDEQ 2011a). As noted above, between the mouths of Thompson and S. creeks the Salmon River is 303(d)-listed for not supporting the cold water aquatic life beneficial use due to sedimentation/siltation and water temperature. The ability of this portion of the Salmon River to support domestic water supply, primary contact recreation, and salmonid spawning was not assessed (IDEQ 2011a). Upstream of the mouth of Thompson Creek, the Salmon River fully supports all of its beneficial uses (cold water aquatic life, primary contact recreation, salmonid spawning, and domestic water supply) (IDEQ 2011a). As the 303(d) listing of the Salmon River between the mouths of Thompson and S. creeks is not for any

constituents other than temperature and sedimentation/siltation, the baseline condition for the Salmon River for chemical contaminants and nutrients is *properly functioning/functioning appropriately*.

Peak/Base Flows

Streamflow in the upper Salmon River is similar to other snowmelt-driven systems, with the highest flows occurring in later spring to early summer, and lowest flows during late fall/winter. The Salmon River has historically meandered across the valley bottom, with complexes of beaver dams, willows, and thick stands of cottonwoods. However, land use has altered the river, primarily through riparian/streambank alterations and water diversions for agriculture (BLM 2011). Consequently, streamflow has been reduced, particularly during summer months, and the baseline condition is *functioning at risk*.

3.8.1.4. Fish Populations

Thompson Creek

The Thompson Creek watershed provides habitat for multiple fish species, including both resident and anadromous salmonids. The majority of fish monitoring for the mine is concentrated on four sites: TC0, TC1, TC4, and TCR (Figure 3.8-1). Long-term data exists for only the original two sites (TC1 and TC4). Fish presence/absence is described using results from all four sites; however, only data from TC1 and TC4 is used to compare fish populations over the life of the mine, as well as between the upstream and downstream sites. The IDFG sampled 15 sites in the Thompson Creek watershed in summer 2004 (IDFG 2005a), twelve sites on Thompson Creek, one site on Alder Creek (which joins Thompson Creek opposite Buckskin Creek), and two sites on unnamed tributaries to Thompson Creek upstream of the mouth of Buckskin Creek. In addition, the Forest Service has one long-term monitoring site on upper Thompson Creek (approximately 3.6 miles upstream of Buckskin Creek) that was sampled in August 2007 (USFS 2008b).

Salmonid species currently documented to occur in Thompson Creek include bull trout, Chinook salmon, steelhead/rainbow trout, and westslope cutthroat trout (GEI 2011, IDFG 2005a, USFS 2008b). In addition, two species of sculpin may be present, and whitefish were present historically (GEI 2011). Spawning and rearing habitat for several key species, including Chinook salmon and steelhead, also probably was present in Thompson Creek historically. Despite documentation of the continued use of Thompson Creek for rearing, the current usage for spawning is unknown.

Multiple-pass electrofishing was used to sample fish populations at the monitoring sites for the mine in late summer or fall of most years during 1980 to 2010 (GEI 2011). However, fish were counted by snorkeling during the summer in 2000, 2002, and 2003 (GEI 2011). Accordingly, to minimize the variability in fish density estimates due to the sampling procedures, data from 2000, 2002, and 2003 was omitted (Table 3.8-3). In addition, Chadwick (2003a) collected cutthroat trout and rainbow trout in 1998 from Thompson and S. creeks to evaluate the degree of hybridization between the species. Based on morphological features, cutthroat trout in Thompson Creek were greater than 50 percent cutthroat trout, but had substantial hybridization with rainbow trout. As a result, Chadwick (and later GEI) classified all cutthroat or rainbow

trout in Thompson and S. creeks as cutthroat/rainbow trout hybrids (Chadwick 2003a, GEI 2011). Although cutthroat trout and rainbow trout are discussed separately in the following sections, density estimates (1 km ≈ 0.6 mile) are for cutthroat/rainbow trout hybrids (Table 3.8-3).

Table 3.8-3. Thompson Creek fish density estimates (number/km).

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin
TC4				
1980	41	72	0	667
1981	10	236	0	564
1982	11	317	0	1,127
1983	0	260	0	1,389
1984	31	244	0	687
1985	0	697	0	321
1986	0	305	0	183
1989	13	575	0	1,264
1990	0	131	0	492
1991	11	165	0	593
1994	0	44	0	560
1996	0	146	0	439
1997	0	159	0	331
1998	0	216	0	997
2001	0	516	0	1,143
2004	0	109	0	1,130
2005	0	70	0	996
2006	0	254	0	714
2007	11	226	0	548
2008	0	375	0	979
2009	0	333	0	1,075
2010	11	202	0	865
TC1				
1980	29	231	39	1,033
1981	11	285	164	1,324
1982	9	234	63	1,258
1983	0	211	85	1,169
1984	14	324	0	1,155
1985	0	1,240	0	690
1986	0	699	0	293
1989	12	434	0	3,546
1990	0	295	0	1,368
1991	0	179	0	477
1994	0	154	0	549

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin
1996	0	124	0	295
1997	0	89	0	480
1998	0	66	0	875
2001	0	1,022	0	1,413
2004	0	53	0	1,085
2005	0	35	0	1,232
2006	0	185	0	435
2007	0	265	0	500
2008	10	495	0	610
2009	0	189	0	541
2010	0	355	0	953

Modified from GEI (2011). To ensure comparability, fish density estimates were produced from the results of the first electrofishing pass at each site.

Special Status Species

Bull Trout

The IDFG identified (from electrofishing) five juvenile bull trout in Thompson Creek approximately 10 miles upstream from its mouth (IDFG 2005a). In addition, the Forest Service identified five juvenile bull trout 9.1 miles upstream of the mouth of Thompson Creek (USFS 2008b). Both of these locations are upstream of all mine monitoring sites. In 6 of the 10 years between 1980 and 1991, bull trout were present in low numbers at TC4. Bull trout were also present at TC1 in 5 of the 10 years during the same time period, but in slightly lower numbers than at TC4 (Table 3.8-3). Bull trout were not identified again at these two sites until 2007. However, bull trout may have been present in Thompson Creek but not identified, i.e., electrofishing at a sampling site may not collect all fish species in the reach, and species with low numbers of individuals are prone to being missed during surveys. Bull trout may also have been present during the years sampling was not conducted. Since 2007, they have again been identified in several years at these sites. It is unclear whether bull trout were not identified at these sites between 1991 and 2007 due to the potential limitations discussed above, or if they were not present due to mine activity, natural variability, or other unknown factors. With only 3 years of pre-TCM data (1980 to1983), it is difficult to determine if the numbers of bull trout were as variable prior to the mine as they have been since. The mine operations have been fairly consistent during the period of record (1980 to 2010) and do not appear to be connected to the low and variable numbers of bull trout sampled during monitoring efforts. The WQS for selenium was exceeded during low flow during 2000 to 2004 due to seepage from the Buckskin WRSF. However, such exceedance would not explain the low numbers (or absence) of bull trout in samples prior to 2000 or since 2004.

It is unknown whether bull trout in Thompson Creek exhibit a resident or fluvial life history, but at least historically both life histories were probably present (IDFG 2005a). The IDFG (2005b) reported that all bull trout captured in 2004 were juvenile fish with lengths from 80 to 100 mm.

All fish captured at the Forest Service monitoring site were also juvenile fish, with lengths from 47 to 56 mm (USFS 2008b). This absence of adults in the IDFG and Forest Service surveys suggests at least a portion of the bull trout population may be composed of fluvial fish (i.e., the adults had migrated downstream to the Salmon River). However, bull trout captured at the monitoring sites for the mine in 2010 were larger (245 mm at TC4, 232 mm at TC0) (GEI 2011). These results are similar to other results from the sites in other years. The larger fish could be resident adults or fluvial subadults, and the life history of bull trout in Thompson Creek remains uncertain based on the existing data.

Chinook Salmon

Juvenile Chinook salmon use the lower reaches of Thompson Creek as rearing habitat and as thermal refuge from the higher temperatures found in the Salmon River (IDFG 2005a). Juvenile and young of the year (YOY) Chinook have been collected in Thompson Creek downstream of the USGS gage by both the IDFG and TCMC. In the IDFG samples, 18 juvenile Chinook salmon were collected from the lowest site (STCO1 to STCO2, Figure 3.8-1.) near the mouth of Thompson Creek (IDFG 2005a). Chinook have been collected at site TC0 every year since 2005 (the first year that site was established), although generally in low numbers (e.g., 1 to 17 individuals each year during 2005 to 2010). There were six YOY Chinook salmon collected at the site in 2010. However, Chinook salmon have not been collected upstream of TC0 during sampling at the other TCMC sites (Figure 3.8-1). The initial fish surveys on Thompson Creek prior to mine development in 1981 documented juvenile Chinook salmon as far as 2 miles above the mouth of Thompson Creek (VTN 1980c), which is approximately halfway between TC0 and TC1. Juvenile Chinook may still be present within this same distance from the Salmon River, but without sampling between TC0 and TC1, the current usage upstream of TC0 is unknown. It is also unknown if Chinook salmon spawn in Thompson Creek.

Steelhead/Rainbow Trout

Juvenile wild steelhead and/or resident rainbow trout have been present in Thompson Creek since sampling began. However, as previously discussed, all Thompson Creek and S. Creek steelhead/rainbow trout and westslope cutthroat trout have been classified as rainbow/cutthroat trout hybrids (Chadwick 2003a, GEI 2011). Hybrid trout have been reported at all sites in all years (Table 3.8-3). The IDFG differentiated between steelhead/rainbow trout and cutthroat trout during their sampling based on external characteristics (i.e., fish with a red slash under the jaw were classified as cutthroat trout). The IDFG collected steelhead/rainbow trout from the seven lowermost sites on Thompson Creek, with fish found in upstream reaches appearing to be cutthroat trout (IDFG 2005a) (Figure 3.8-1). Although the densities of rainbow/cutthroat trout hybrids (as classified by GEI) at TC1 and TC4 have varied throughout the years, the amount of variation is not atypical of western streams for which annual variations of 50 percent or more are common (GEI 2011, Platts and Nelson 1988).

Populations of rainbow/cutthroat hybrid trout include multiple age classes and the presence of adult fish indicates that at least a portion of the population consists of resident rainbow and/or cutthroat trout (GEI 2011, IDFG 2005a). However, the densities of adult trout at the monitoring sites for the mine are typically low, with the populations typically dominated by juvenile and YOY fish (GEI 2011). As a result, it appears that some of the fish are of steelhead origin, or in the case of cutthroat trout, fluvial migrant fish as discussed below for westslope cutthroat trout.

Westslope Cutthroat Trout

Westslope cutthroat trout are widely distributed in Thompson Creek, with westslope cutthroat trout or rainbow/cutthroat trout hybrids (as classified by GEI 2011) collected from all sites along the stream (GEI 2011, IDFG 2005a) (Figure 3.8-1). The IDFG (2005b) reports fish in the uppermost reaches of Thompson Creek may be less hybridized based on external characteristics. Both the IDFG data and the long-term data from the monitoring sites for the mine show low densities of adults (GEI 2011, IDFG 2005a), indicating a population that may include fluvial fish. The IDFG (2005b) cites unpublished IDFG data from a radio-telemetry tracking study of westslope cutthroat in 2004 that indicates some fish may use Thompson Creek briefly for spawning before returning to the Salmon River.

S. Creek

The Lower S. Creek watershed also provides habitat for multiple fish species, including both resident and anadromous salmonids. Salmonid species currently documented in S. Creek include bull trout, Chinook salmon, steelhead/rainbow trout, westslope cutthroat trout, and mountain whitefish. In addition, two species of sculpin may be present (GEI 2011, IDFG 2004). As for Thompson Creek, the fish density data from snorkeling in 2000, 2002 and 2003 was excluded from this analysis, and the density estimates are for cutthroat/rainbow hybrid trout even though cutthroat trout and steelhead/rainbow trout are discussed separately (Table 3.8-4).

Table 3.8-4. S. Creek fish density estimates (number/km).

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin	Chinook Salmon
SQ3					
1980	0	184	31	810	0
1981	0	777	109	2,101	0
1982	0	308	199	1,143	0
1983	0	241	273	1,761	0
1984	0	383	55	1,048	0
1985	0	556	36	693	0
1986	0	442	36	823	0
1989	0	1,828	79	2,115	0
1990	0	1,934	197	1,115	0
1991	0	385	55	582	0
1994	0	77	0	253	0
1996	0	55	8	518	0
1997	0	51	13	1,079	0
1998	12	1,069	0	1,713	12
2001	8	661	24	1,866	0
2004	0	164	0	846	8
2005	0	99	0	643	0
2006	0	62	7	298	0
2007	9	880	9	1,538	17

Year	Bull Trout	Cutthroat/Rainbow Hybrid Trout	Mountain Whitefish	Shorthead Sculpin	Chinook Salmon
2008	0	393	7	1,511	0
2009	0	363	29	1,275	0
2010	0	757	9	1,243	0
SQ2					
1980	10	434	212	1,463	0
1981	0	602	194	1,849	0
1982	32	516	204	1,527	0
1983	23	292	23	1,076	0
1984	28	706	125	1,939	0
1985	0	2,853	171	3,039	0
1986	0	563	55	1,635	0
1989	0	1,902	110	1,585	0
1990	0	747	76	444	0
1991	11	242	55	934	0
1994	0	72	0	646	0
1996	0	75	7	1,380	0
1997	0	49	16	1,775	0
1998	0	155	7	1,465	0
2001	0	583	19	1,963	0
2004	0	265	8	547	0
2005	0	155	0	538	0
2006	0	59	0	400	0
2007	0	290	11	1,108	0
2008	0	586	14	545	0
2009	0	257	15	1,147	0
2010	0	245	7	1,281	0

Modified from GEI (2011). To ensure comparability, fish density estimates were produced from the results of the first electrofishing pass at each site.

Special Status Species

Bull Trout

Bull trout have only been captured sporadically at the TCM monitoring sites since 1980 (Table 3.8-4). During the IDFG fish surveys in 2003, bull trout were present only at SQ3 on S. Creek in the upper watershed (IDFG 2004). Therefore, it appears bull trout use of S. Creek is low, and it is unclear if the fish present are resident, fluvial, or both.

Chinook Salmon

Juvenile Chinook salmon were present at the upstream site (SQ3) in 1998, 2004, and 2007. Chinook have not been present at the lower site (SQ2) since sampling began in 1980. However, Chinook salmon juveniles use the lower reaches of S. Creek for rearing and thermal refuge

(IDFG 2004). The IDFG (2004) found Chinook salmon juveniles in four transects between the mouth of S. Creek and the mouth of Redbird Creek (just upstream of Bruno Creek). Fish densities were highest near the mouth of S. Creek (11.4 fish per 100 m^2; 100 $m^2 \approx$ 1,000 square feet), decreasing rapidly upstream (0.17 fish per 100 m^2 at the most upstream site). It is unknown if Chinook salmon spawn in S. Creek.

Steelhead/Rainbow Trout

Steelhead/rainbow trout are relatively abundant in lower S. Creek and both resident and anadromous life histories are present, with spawning in lower S. Creek documented in 1986 (IDFG 2004) and in 2012 (BLM 2012b). A BLM survey on May 1, 2012 of S. Creek from the BLM/private land boundary below the mouth of Bruno Creek upstream to the historic Redbird Mine documented eight steelhead adults and one spawning redd in progress. A subsequent survey on May 10, 2012 documented three steelhead adults and two completed redds (BLM 2012b). Steelhead in S. Creek have been supplemented by releases of B-run steelhead smolts into S. Creek, as well as from South Butte Pond. In addition, resident rainbow trout have been stocked in S. Creek and South Butte Pond. During IDFG surveys in 2003, many of the larger rainbow trout sampled appeared to be stocked fish; either stocked steelhead that adopted a resident life history or one of the other strains of stocked rainbow trout (IDFG 2004).

Cutthroat/rainbow trout hybrids have been collected at both S. Creek monitoring sites since 1980 (Table 3.8-4). All age classes have been present, indicating the population includes resident fish. However, adult abundance is generally low, indicating the population may include a migratory life history component as well (GEI 2011). A statistically significant decline in fish density has occurred at the downstream site (SQ2) since 1980, which indicates a decline in the quality of fish habitat (GEI 2011). As sampling procedures and sample site locations were consistent between years (other than the years when fish were counted by snorkeling, with such data excluded from analysis), this decline is probably not an artifact of sampling. GEI (2011) reports an increase in macroinvertebrate density and taxa richness, which can correlate with improved conditions. However, other factors such as changes in habitat, an increase in width/depth ratio, or changes in stocking may also be involved (GEI 2011).

Westslope Cutthroat Trout

As discussed above for steelhead/rainbow trout, hybrid trout are prevalent in S. Creek with both resident and migratory life histories likely present. Population dynamics for westslope cutthroat trout at the TCM monitoring sites are also the same as discussed above for steelhead/rainbow trout. The IDFG (2004) differentiated between rainbow trout and westslope cutthroat trout, and reports westslope cutthroat trout to be the most abundant species in S. Creek. The westslope cutthroat trout are primarily upstream of the mouth of Bruno Creek, with rainbow trout more dominant below the mouth of Bruno Creek, and one hybrid trout near the mouth of Bruno Creek. Westslope cutthroat trout were present in all tributaries, including Bruno Creek (discussed below).

Bruno Creek

Both cutthroat trout and rainbow trout were present in Bruno Creek in 1980, with a resident population of cutthroat trout indicated by the presence of both adults and juveniles (VTN 1980c). VTN (1980c) also states that the Bruno Creek fish populations would be lost due to construction

of the TSF. The TSF eliminated fish habitat and any fish populations in the middle portions of the stream; however, the IDFG collected westslope cutthroat trout from the portions of the stream above and below the TSF in 2004 (IDFG 2004). Upstream of the TSF, the IDFG collected 25 westslope cutthroat trout ranging from 41 mm to 168 mm in length. However, there were no fish identified above the TSF in sampling conducted by the Forest Service in 2013. Downstream of the TSF, the IDFG collected 16 westslope cutthroat trout ranging from 81 mm to 251 mm in length. Fish cannot move from S. Creek into Bruno Creek due to a decant tower at the mouth of Bruno Creek that prevents upstream migration.

Mill Creek

Mill Creek has very minimal flow during much of the year and discharges into the SRD through the right abutment of the TSF main drain. As a result, there is no surface connection to the fish-bearing portions of Bruno Creek, and there are no known fish populations in Mill Creek.

Salmon River

The Salmon River supports various life stages of all species described for Thompson Creek and S. Creek (Table 3.8-1). The Salmon River is one of the major Chinook salmon and steelhead spawning and rearing waters in the Upper Salmon River watershed. The main Salmon River is also a migration corridor for sockeye salmon (BLM 1998). In addition to using tributary streams for spawning and rearing, most salmonids (including bull trout, Chinook salmon, and steelhead) will use the lower portions of tributary streams as thermal refuges from relatively high seasonal temperatures in the main Salmon River.

3.8.1.5. Benthic Macroinvertebrate Communities

Biological monitoring of benthic macroinvertebrate populations began in 1980 with two sites on Thompson Creek and two sites on S. Creek. The monitoring has since expanded to six sites on Thompson Creek, two sites on S. Creek, and two sites on the Salmon River (Figure 3.8-1). Benthic macroinvertebrate communities were sampled several times per year during 1980 to 2001, but have been sampled once annually (in summer) since 2001 (GEI 2011). The description of benthic macroinvertebrate populations uses data from 1980 to 2010. Discussion of the last year in the period of record (2010) is used to provide a snapshot of current conditions. However, due to natural variability that can occur in benthic macroinvertebrate communities, the long-term dataset is also used to describe the macroinvertebrate communities over time and highlight any trends.

On Thompson and S. creeks, three replicate Hess samples have been collected from riffle habitat at each site in all years. Sample collection on the Salmon River has been similar, but has varied slightly between years. Having three replicate samples at each site allows statistical analyses to be conducted on the data and on various metrics (GEI 2011). The common metrics analyzed in the annual reports are total macroinvertebrate density; total taxa richness; combined taxa richness for the orders Ephemeroptera, Plecoptera, and Trichoptera (referred to collectively as EPT taxa); and the percentage of the community composition made up of Ephemeroptera (percent Ephemeroptera abundance) (Barbour et al. 1999, Karr and Chu 1998).

In addition, the replicate data is composited to describe the composition of macroinvertebrate communities at each site and to calculate metrics used to determine the stream macroinvertebrate

index (SMI) and the river macroinvertebrate index (RMI). The SMI and the RMI are indices developed by the IDEQ (Grafe 2002a, Grafe 2002b). Note that the composite data is not appropriate for use in statistical tests. Values from both the replicate and composite data are summarized in the following descriptions of macroinvertebrate communities.

Stream Macroinvertebrate Index

The SMI includes nine metrics that when scored produce an index that provides an overall measure of aquatic conditions present at the sampled site. Development of the SMI included sampling streams known to be minimally affected by anthropogenic factors (i.e., streams that include high-quality habitats and good water quality). The index is organized such that an overall higher score, derived as a sum of the nine metrics, indicates a stream is in good condition. A low score indicates the stream has been degraded relative to its potential score. The metrics used in the SMI are total taxa richness; EPT taxa richness; percent composition of Plecoptera (stoneflies); Hilsenhoff Biotic Index (HBI); the percent dominance of the five most common taxa in the sample; percent composition of organisms in the "scrapers" feeding group; and percent composition of organisms in the "clinger" feeding group. SMI scores range from 0 to 100, with rating categories assigned based on score. For the central and southern mountains in Idaho, the rating categories are very good (80 to 100), good (59 to 79), fair (40 to 58), poor (22 to 43), and very poor (0 to 19) (Grafe 2002a).

River Macroinvertebrate Index

The RMI is similar to the SMI, but with only five metrics, as many of the SMI metrics had low predictive power in larger river systems (Grafe 2002b). The RMI metrics are total taxa richness; EPT taxa richness; percent composition of Elmidae; percent dominance of the most common taxa in the sample; and the percent composition of organisms in the "predators" feeding group. The indications provided by total taxa richness; EPT taxa richness, and; percent dominant taxa are as described above for the SMI. Both the relative abundance of riffle beetles in the order Elmidae and the percent composition of organisms in the predator functional feeding group are expected to decrease with decreases in water quality. Lower amounts of riffle beetles indicate the impairment of well-oxygenated riffle and run habitats, with a lower percentage of predators being an indication of reduced abundance and diversity in invertebrate prey (Grafe 2002b).

Chemicals (Metals)

Benthic macroinvertebrate organisms are exposed to metals in surface water through direct uptake from the water, through ingestion of contaminated food (periphyton, detritus, other invertebrates), or through incidental ingestion of sediment (Merritt and Cummins 1984). Although macroinvertebrate density (abundance) may be affected by elevated concentrations of metals, macroinvertebrate density does not typically provide a good measure of the effects of metals because metal-sensitive macroinvertebrate organisms may be replaced by metal-tolerant ones. Instead, the effects of elevated concentrations of metals on macroinvertebrate organisms are better evaluated from changes in macroinvertebrate community composition, with fewer metal-intolerant taxa such as EPT taxa. This may be particularly true for Ephemeroptera (mayflies) which have been shown to be particularly sensitive to metals pollution (Warnick and Bell 1969).

Thompson Creek

Samples of macroinvertebrate communities have been collected from TC4 and TC1 since 1980. An additional site (TC0) was added in 2005, with two more sites (TCR and TJM4) added in 2006 (Figure 3.8-1). The macroinvertebrate density increased downstream in 2010, as is common for mountain streams, with no statistically significant differences in total richness or EPT taxa richness between the six sites. The mean percentage of the community composed of Ephemeroptera taxa did differ statistically between sites, but the Ephemeroptera abundance was substantially lower at TCR than at TC4 or TC3A. Below TC3A, the Ephemeroptera abundance decreased downstream, with the abundance at TC0 statistically lower than at TC3A (GEI 2011). The decrease from TC3A (downstream of Buckskin Creek) through TC0 suggests possible effects from the mine. However, the lowest Ephemeroptera abundance was at TCR, which is upstream of the mine, and Ephemeroptera abundance did not differ statistically between TCR and TC1 (downstream of Pat Hughes Creek). As a result, the differences may be due to natural variation. In addition, the number of Ephemeroptera taxa (sensitive to metals) was higher (although not statistically comparable as it was taken from composite data) at downstream sites (TC-3A, TC-1, TC-0) than at TC-R or TC-4; the number of Ephemeroptera taxa at TJM4 was similar to that at the downstream sites.

The long-term data shows no clear trend in Ephemeroptera abundance between TC-4 (upstream of mine activity) and TC1 (downstream) (Chadwick 1984 to 1988, Chadwick 1990 to 2006, and GEI 2007 to 2010). Furthermore, the values of the SMI metrics were similar between all sites in 2010. The values of the SMI metrics during 2006 to 2010 also show no clear difference between sites or between years, and no statistically significant difference has been detected in the long-term mean values of the SMI metrics or taxa richness between sites. The SMI scores in Thompson Creek have consistently rated in the "very good" and occasionally "good" categories (GEI 2011).

The values of the SMI metrics for TC4 (upstream of Buckskin Creek) and TC1 (downstream of Pat Hughes Creek) during 1980 to 2000 show a high degree of variability (i.e., no consistent pattern of one site always rating lower or higher than another) (Chadwick 2001). Furthermore, substantial annual variability in density and richness have been well documented over the monitoring period (GEI 2011). Despite the annual variability, regression analysis done on the long-term data shows increasing trends for density and richness, and historical data has shown total density and taxa richness to be negatively correlated with streamflow (GEI 2011). As a result, at least some of the variability may be due to natural variation. The number of Ephemeroptera taxa has consistently been high (rating very good) at all sites, which indicates low concentrations of metals in the water. Two metrics have consistently performed poorly: percent Plecoptera and the HBI (Chadwick 2001). Since Plecoptera abundance is low and the HBI is high (high HBI values indicate macroinvertebrate communities have a disproportionate number of species tolerant to low quality conditions) at both upstream and downstream sites, it appears that some activity other than the mine may be creating conditions that are less than ideal for Plecoptera. Overall, if macroinvertebrate communities have been affected by the mine, the effects have not been greater than that from natural variability.

S. Creek

Data from the two sites on S. Creek in 2010 (GEI 2011) indicate macroinvertebrate community composition was similar between the sites, with no statistically significant differences in density, taxa richness, or EPT taxa richness. However, the percent Ephemeroptera was statistically lower at SQ2. Ephemeroptera richness, Plecoptera richness, Trichoptera richness, and scraper taxa richness were also lower at SQ2 in 2010, and the percentage of the community dominated by the five most common taxa was higher at SQ2. Macroinvertebrate density and percent Plecoptera were higher at SQ2 than at SQ3. Although the lower values for some metrics in 2010 at SQ2 suggest that conditions for macroinvertebrate communities may have been degraded relative to SQ3, the long-term mean taxa richness and the long-term mean SMI scores are not statistically different between sites (GEI 2011). Rather, the values of the SMI metrics during 1980 to 2000 show the SMI rating for SQ2 has being highly variable, with some years being rated as very good and others poor (Chadwick 2001). The SMI scores for Site SQ3 were less variable during this time period (more consistently rated good to fair) (Chadwick 2001). Furthermore, the long-term data shows that the number of Ephemeroptera taxa has consistently been high (very good) at both sites (indicating low concentrations of metals) and both sites were rated good (SQ2) and very good (SQ3) on the SMI in 2010 indicating the streams at these sites continue to support healthy macroinvertebrate populations (GEI 2011).

As described for Thompson Creek, macroinvertebrate density appears to be inversely related to streamflow (GEI 2011). Also, the metrics for percent Plecoptera and HBI perform poorly, indicating less than ideal conditions for stoneflies and possible pollution, respectively. Note that water seeping from the TSF into Redbird Creek discharges upstream of SQ3. As a result, it is difficult to determine potential effects of the mine due to seepage to Redbird Creek based on analysis of the two monitoring sites. Inflow from Bruno Creek could similarly affect conditions at SQ2; however, beaver activity at these sites and associated changes in sediment (Section 3.8.1.3.) may also be a factor in the poor scores for percent Plecoptera, the HBI, and some of the metrics at SQ2 in 2010.

Salmon River

Analysis of macroinvertebrate density in 2010 (GEI 2011) between sites using the replicate data shows a statistical difference in macroinvertebrate density between the two sites, with density higher at the downstream site (SR1) than at the upstream reference site (SR3). However, there were no statistical differences between taxa richness and EPT tax richness. Ephemeroptera abundance was statistically higher at SR3, and values for all RMI metrics calculated from the composite data were also higher at SR3 than at the downstream site. As a result, aquatic conditions at SR3 in 2010 appear to be better than at SR1. However, the long-term data shows that there is no statistically significant difference in taxa richness between sites. Furthermore, the RMI metrics shows no clear trend of one site having consistently higher values, or of a decrease in values from year to year and there is no statistically significant difference between the long-term mean RMI scores at the two sites. Rather, interannual variability appears high at both sites.

Variability in macroinvertebrate density at both sites since 2001 is substantial, and total taxa richness has varied substantially between 2001 and 2003, but has been less variable since 2004 (GEI 2011). Similar to Plecoptera richness for Thompson Creek and S. Creek, percent Elmidae

was low at both sites in 2010, and has decreased since 2006. The lower percent Elmidae may indicate impairment of well-oxygenated riffle and run habitats. However, the value of this metric has declined at both sites, and has typically been lower at the upstream site. Therefore, the lower percent Elmidae does not appear to be due to the mine, and rather is probably due to natural variability.

3.8.2. Offered Lands - Broken Wing Ranch

The majority of the ranch is along the Salmon River bottom lands adjacent to the (ordinary high water mark) of the Salmon River. The ranch includes part of the adjacent Salmon River floodplain and the lower portions/mouths of several small tributary streams (Sink Creek and Lyon Creek, as well as unnamed tributaries). Most of the valley areas and Salmon River floodplain at the ranch are cultivated or otherwise disturbed for agricultural use. As a result, there is only scattered cottonwood along the Salmon River corridor. Lyon Creek has a more developed riparian corridor. The foothills at the ranch contain varying amounts of bare ground (gravel/cobble substrate) and grass and shrub vegetation.

3.8.2.1. Lyon Creek

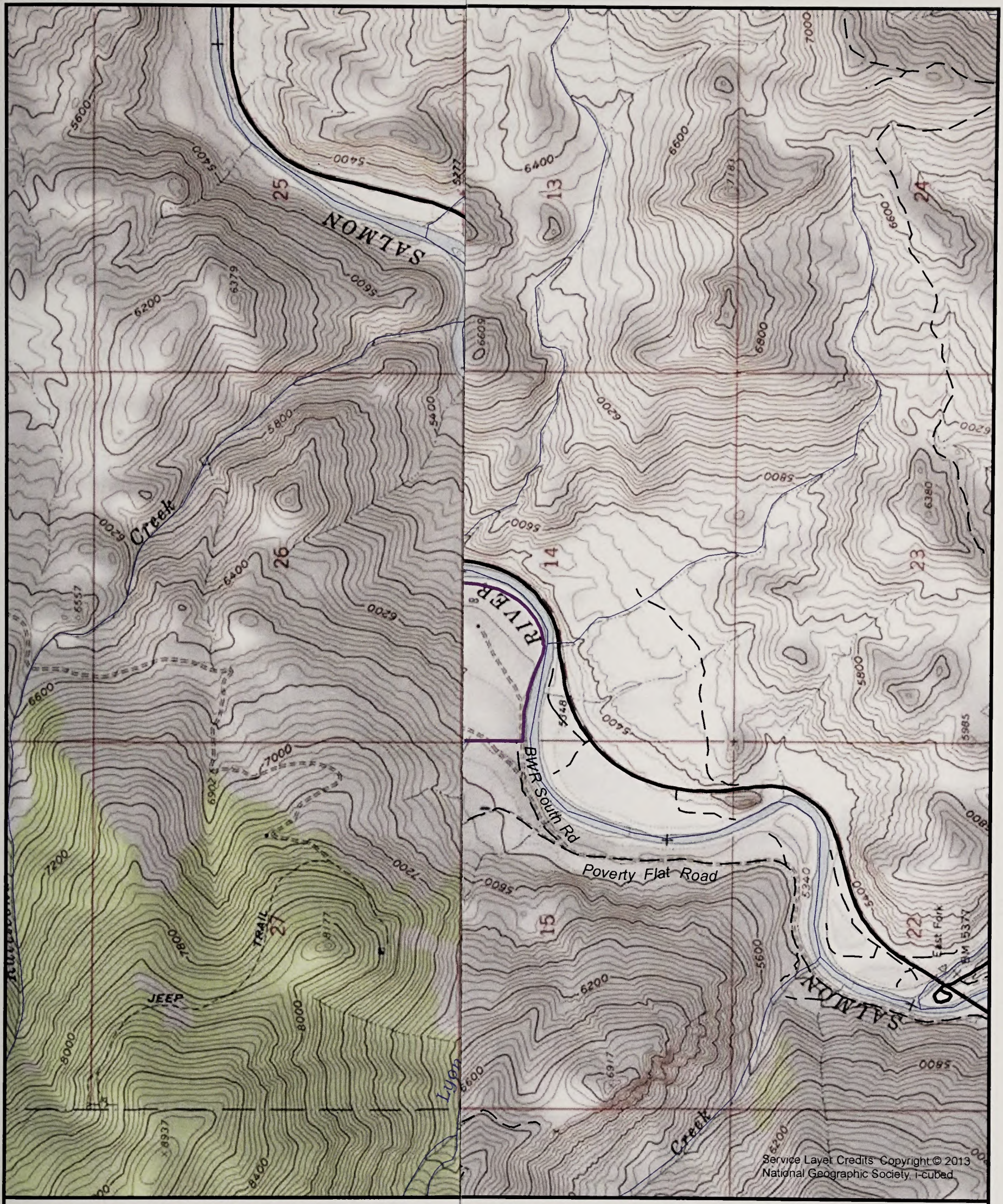
The Lyon Creek watershed is 4,102 acres. Nearly all (93 %) of the watershed is Federal land administered by the BLM and Forest Service, with the remaining area of the watershed owned by TCMC. The status of benthic macroinvertebrate communities in Lyon Creek is unknown.

3.8.2.2. Fish Species Present

Both the Salmon River and Lyon Creek support populations of native fish, including anadromous and resident salmonids. In addition, other native species may be present in the Salmon River or may use Lyon Creek at some point in their life history (Table 3.8-5). It is likely that Lyon Creek has historically provided spawning and rearing habitat for Chinook salmon and steelhead, and may also have supported resident and fluvial westslope cutthroat trout, bull trout, and resident rainbow trout (IDFG 2010b). The species documented in Lyon Creek at varying extents of occupancy include steelhead/rainbow trout, juvenile Chinook salmon, bull trout, shorthead sculpin, and longnose dace (IDFG 2010b). A dam/pond and an undersized culvert outlet near the mouth of Lyon Creek create a substantial impediment to upstream migration by anadromous and fluvial fish under most flow conditions (Section 3.6.2.1). However, BLM data (e.g., BLM 2011) and steelhead spawning surveys by the BLM in 2014 found redds upstream of the dam/pond, indicating some fish passage during spring flows.

Special Status Species

There are four fish species listed as threatened or endangered that use components of the analysis area for a portion of their life history: bull trout, Chinook salmon, sockeye salmon, and steelhead (Table 3.8-5). Resident rainbow trout are also present in the analysis area. The Salmon River is designated critical habitat for bull trout, Chinook salmon, sockeye salmon, and steelhead. Lyon Creek is designated critical habitat for Chinook salmon, but not for bull trout, sockeye salmon, or steelhead.



c Sciences.

Legend

- Broken Wing Ranch
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- BLM temperature
- Lyon Creek sampl

Figure 3.8-2
Survey and monitoring locations,
Broken Wing Ranch
Thompson Creek Mine EIS

was low at both sites in 2010, and has decreased since 2006. The lower percent Elmidae may indicate impairment of well-oxygenated riffle and run habitats. However, the value of this metric has declined at both sites, and has typically been lower at the upstream site. Therefore, the lower percent Elmidae does not appear to be due to the mine, and rather is probably due to natural variability.

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3.8.2.1. Lyon Creek

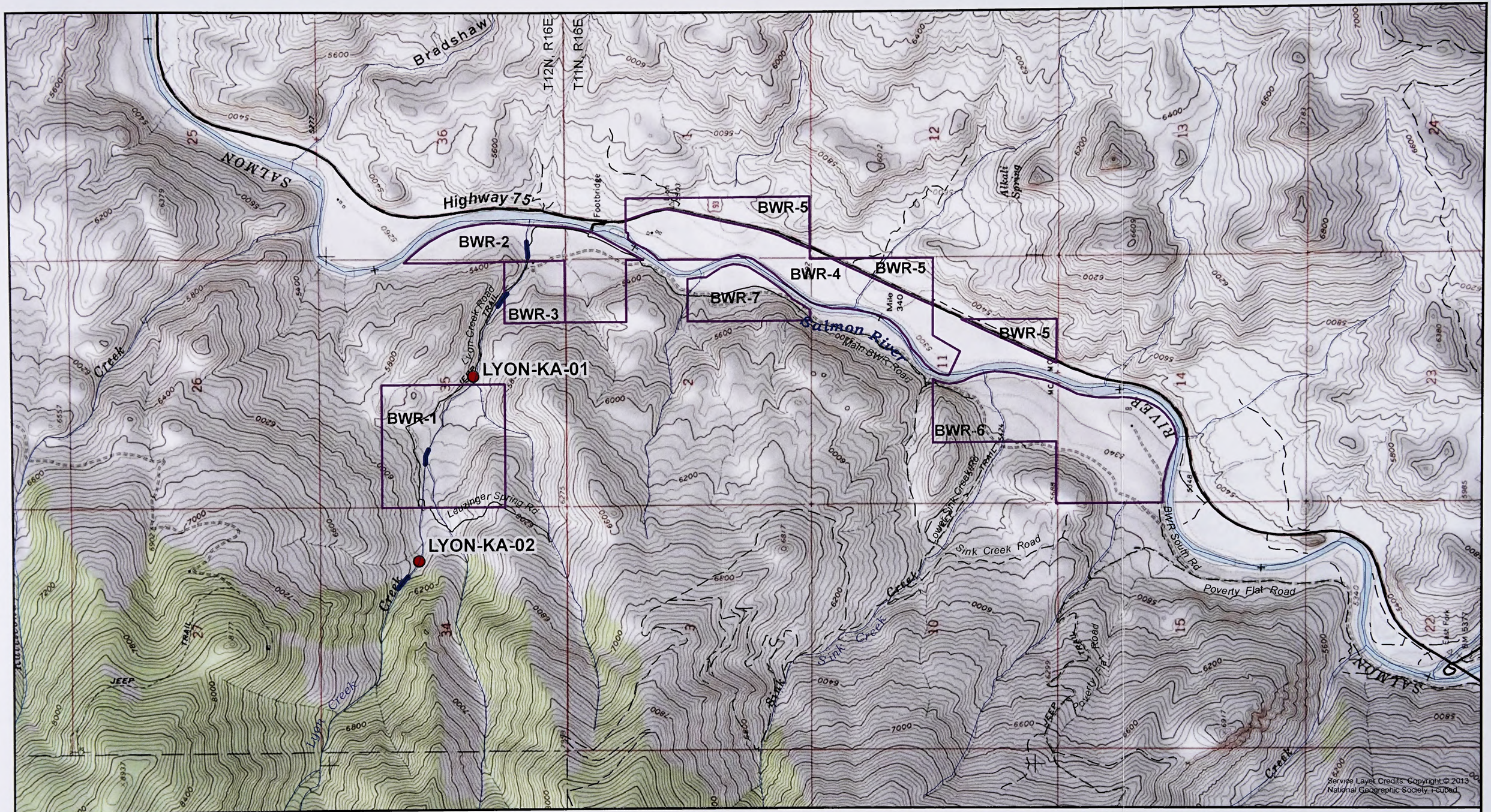
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Special Status Species

There are four fish species listed as threatened or endangered that use components of the analysis area for a portion of their life history: bull trout, Chinook salmon, sockeye salmon, and steelhead (Table 3.8-5). Resident rainbow trout are also present in the analysis area. The Salmon River is designated critical habitat for bull trout, Chinook salmon, sockeye salmon, and steelhead. Lyon Creek is designated critical habitat for Chinook salmon, but not for bull trout, sockeye salmon, or steelhead.



Legend

- Broken Wing Ranch
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- BLM temperature monitoring sites (2010-2011)
- Lyon Creek sample reaches

NEPA parcels for the Broken Wing Ranch from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Temperature monitoring sites and Lyon Creek sample reaches from BLM and IDFG
Topographic background from USGS 7.5' Quadrangles 1:24,000 scale.
Coordinate system UTM Zone 11 NAD 83

N

0 1:24,000 4,000
Feet

0 1
Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.8-2
Survey and monitoring locations, Broken Wing Ranch
Thompson Creek Mine EIS

3.8.2.3. Aquatic Habitat

The aquatic data collection sites on the ranch include a site near the mouth of Lyon Creek below the small earthen dam and pond, another site just upstream of the pond, and one site further upstream in BWR-1 (Figure 3.8-2). The water quality in Lyon Creek is good, with temperatures generally less than NMFS criteria for Chinook salmon or steelhead spawning, and near or less than USFWS thresholds for bull trout rearing (BLM 2011). The temperatures can be greater than those acceptable for bull trout spawning during late summer months (BLM 2011).

Limited data on sediment and turbidity is available. The BLM quantified the surface substrate at the upper site (LYON-KA-02) in 2011 and found the percentage of fine sediment to be approximately 14 percent (BLM 2011). However, the site is above some additional sources of sediment to lower Lyon Creek: a breached irrigation ditch flowing into Lyon Creek, livestock grazing, and a road (with a ford next to the Lyon Creek ranch house and a ford 450 feet downstream to access the north end of BWR-2 as well as two other fords nearby) next to the lower portion of the stream.

The lower portions of Lyon Creek on BLM land are also confined by steep hillslopes with relatively erodible fine volcanic soil (BLM 2011). Furthermore, lack of maintenance of the flood-irrigated BWR-1 has caused rills that may transport sediment seasonally to Lyon Creek. Sediment has also been seen entering Lyon Creek from the road in the same area. In addition, there are visible increases in turbidity when vehicles use the fords. However, even during the growing season, the fords are on average used less than once per week. In any case, the amount of fine sediment may be higher than the 12 percent recommended level in some portions of Lyon Creek. Moreover, reduced streamflow due to irrigation diversions may limit the ability of the stream to transport sediment downstream, which would also increase the amount of sediment in the substrate. The sediment and relatively little pool habitat in the lower 1,850 feet of Lyon Creek probably limit salmonid spawing potential.

There is an earthen dam/pond on Lyon Creek 300 feet upstream of the mouth of Lyon Creek. A control gate and an undersized culvert outlet (1 foot in diameter) on the downstream end of the pond may impede upstream fish migration at a range of flows. However, two bull trout were found above the pond during a BLM fish survey in 2008. As discussed below for bull trout, the bull trout in Lyon Creek do not appear to be resident fish and thus some fish passage through the pond is inferred (BLM 2011). In addition, there are five other irrigation diversions upstream of the pond that may prevent upstream migration of smaller fish. The diversions are unscreened (one was subsequently screened in 2012) and may entrain fish (IDFG 2010b). There is also a portion of Lyon Creek (~ 1,600 feet) upstream of BWR-1 that appears to be intermittent where the water enters a subsurface channel before resurfacing 1.9 miles upstream of the mouth of Lyon Creek. Although this section probably has water during high flow, the section is a barrier to upstream migration at lower flows. The irrigation diversions on Lyon Creek, four of which were actively withdrawing water from Lyon Creek in 2009 (IDFG 2010b), also reduce streamflow relative to natural conditions.

Table 3.8-5. Fish Species in the Broken Wing Ranch analysis area.

Species	Status	Occurrence
SPECIAL STATUS SPECIES		
Bull trout	Threatened/MIS	**Present** Bull trout are present in the Salmon River and lower Lyon Creek (IDFG 2010b). The Salmon River is designated critical habitat for bull trout, but Lyon Creek is not.
Chinook salmon	Threatened/MIS	**Present** Chinook salmon are present in the Salmon River and lower Lyon Creek (IDFG 2010b) and both of these streams are designated critical habitat for Chinook salmon.
Steelhead/rainbow trout	Threatened (steelhead) MIS/BLM sensitive (rainbow trout)	**Present** Juvenile steelhead/rainbow trout (indistinguishable) are present in the Salmon River and lower Lyon Creek (IDFG 2010b). The Salmon River is designated critical habitat for steelhead, but Lyon Creek is not.
Sockeye salmon	Endangered	**Present** Sockeye salmon use the main Salmon River for migration to/from central Idaho lakes. The Salmon River is designated critical habitat for sockeye salmon (BLM 1998). Lyon Creek is not designated critical habitat for sockeye salmon.
Westslope cutthroat trout	Forest Service/BLM sensitive/MIS	**Present** Westslope cutthroat trout are present in the Salmon River and were likely historically present in Lyon Creek and may again be present if barriers to migration are removed (IDFG 2010b).
NON- SPECIAL STATUS SPECIES		
Bridgelip sucker		**Possible** Likely present in the Salmon River and may be present in Lyon Creek (BLM 1998, IDFG 2010b).
Largescale sucker		**Possible** May be present in the Salmon River (BLM 1998).
Longnose dace		**Possible** Likely present in the Salmon River and may be present in Lyon Creek (BLM 1998, IDFG 2010b).
Mottled sculpin		**Possible** Likely present in the Salmon River and may also be present in Lyon Creek (BLM 1998, IDFG 2010b).

Species	Status	Occurrence
Mountain whitefish		**Present** Present in S. Creek and the Salmon River and may also be present in Lyon Creek.
Northern pikeminnow		**Possible** May be present in the Salmon River (BLM 1998).
Pacific lamprey		**Possible** Precise distribution data for Pacific lamprey is unavailable for much of the upper Salmon River; however, lamprey once migrated into all Idaho waters that salmon and steelhead migrated into (Simpson and Wallace 1982). Lamprey have been found ~ 75 miles downstream of the analysis area (Curet 2013).
Redside shiner		**Possible** Likely present in the Salmon River and may be present in Lyon Creek (BLM 1998, IDFG 2010b).
Shorthead sculpin		**Possible** Likely present in the Salmon River and may also be present in Lyon Creek (BLM 1998, IDFG 2010b).
Speckled dace		**Possible** Likely present in the Salmon River and may also be present in Lyon Creek (BLM 1998, IDFG 2010b).
White sturgeon		**Not Present** The Snake River population of white sturgeon occurs in the Snake River and in the mainstem Salmon River. White sturgeon are rarely seen above the North Fork Salmon River (~ 100 miles downstream of the analysis area) (IDFG 2005a).

3.8.2.4. Fish Populations

Lyon Creek

The fish community in the portion of Lyon Creek below the pond includes anadromous and fluvial fish, and is used by juvenile Chinook, steelhead/rainbow trout, and bull trout as rearing habitat and as refuge from high summer temperatures in the Salmon River (IDFG 2010b). Upstream of the pond the fish community is composed of what appear to be mostly resident rainbow trout, but some passage above the pond by anadromous and fluvial fish is possible (BLM 2008a, BLM 2011, IDFG 2010b). An intermittent portion of upper Lyon Creek appears to restrict rainbow trout to the lower 2 miles of Lyon Creek, with no fish sampled above this portion of the stream (IDFG 2010b).

Special Status Species

Bull Trout

Two bull trout (both ~ 200 mm in length) were sampled in the lower portion of Lyon Creek below the pond in 2009 (IDFG 2010b). In addition, two bull trout (both ~ 200 mm in length, 3 to 4 years old) were sampled in 2008 just upstream of the pond (BLM 2011). The dam and culvert is a velocity barrier to upstream movement under most flow conditions. However, the bull trout above the pond indicate that some fish passage may occur at low flows. Also, under high flow, a secondary channel may allow limited fish passage. Given the lack of bull trout in other samples of upper Lyon Creek, it is unknown if there are resident bull trout in Lyon Creek above the pond. Therefore, the two bull trout above the pond may have come from the Salmon River seeking refugia, foraging, or spawning habitat (BLM 2011). As mentioned above, the relatively cold water of Lyon Creek provides valuable refuge for fluvial bull trout from high temperatures in the Salmon River.

Chinook Salmon

Juvenile Chinook salmon were sampled on two dates in the portion of Lyon Creek below the pond in 2009: 4 and 29 individuals were identified on June 29 and July 28, respectively. The reach sampled was the same length on both dates, with 3 passes conducted on June 29 and a single pass on July 28. As the greater number of individuals was sampled with less sampling effort, the increase does not appear to be due to sampling error. Given that a greater number of individuals were sampled with less sampling effort, and the increase in individuals corresponded with an increase in the temperature of the Salmon River, Chinook salmon may use Lyon Creek as a thermal refuge, similar to the potential for bull trout (IDFG 2010b). No Chinook salmon have been found above the pond.

Steelhead/Rainbow Trout

Juvenile steelhead/rainbow trout of unknown origin have been present at all sites between the portion of Lyon Creek with intermittent streamflow and the pond (BLM 2008a, IDFG 2010b). The length distribution of rainbow trout (40 to 219 mm) sampled by BLM and IDFG is consistent with the length distribution of resident populations observed in other Salmon River tributaries. However, the length distribution is also consistent with length attainment prior to down migration and the presence of steelhead remains uncertain, i.e., steelhead passage above the pond at low flows (prior to spring run-off) appears possible (BLM 2011). Steelhead spawing surveys by the BLM in 2014 found redds upstream of the pond/dam indicating some fish passage during spring flows. Fish below the pond may be juvenile rainbow trout from resident spawning in Lyon Creek, steelhead from spawning below the pond, or from elsewhere in the Salmon River system that are using the reach as rearing habitat (IDFG 2010b).

Westslope cutthroat trout

Westslope cutthroat trout were not sampled in Lyon Creek, although they are considered to have been present historically (IDFG 2010b).

3.8.3. Garden Creek Property

The portion of Garden Creek within the property is small (Section 3.6.3.) and is not known to support any salmonid fish populations, although small individuals of non-game species such as mottled sculpin, shorthead sculpin, and speckled dace are probably present.

3.9. Wetlands, Floodplains, and Riparian Areas

The analysis area for wetlands, floodplains, and riparian areas for the MMPO alternatives is the surface disturbance of the MMPO (Alternatives M2 and M3) and the wetlands, floodplains, and riparian areas downgradient and proximal to the MMPO (Alternatives M2 and M3). The analysis area for streams determined to be WUS (USACE 2011) is the surveyed stream channels above and/or below the MMPO area to the ends of the channels in Thompson Creek, S. Creek, and the Mill Creek drainage. The Mill Creek drainage is generally outside the MMPO area, but would be disturbed by mine reclamation. Streams determined to be WUS in the MMPO area are Buckskin Creek, Buckskin Creek tributary, Pat Hughes Creek, East Fork Pat Hughes Creek, Pat Hughes Creek tributary, No Name Creek, Bruno Creek, West Fork Bruno Creek, "Hawk's Nest" wetland/spring tributary to Bruno Creek, and Mill Creek (Table 3.9-1).

The analysis area for the land disposal alternatives is the selected and offered lands. Wetlands (land saturated with water, either seasonally or permanently), floodplains (streamside areas subject to flooding within a certain interval), and riparian areas (streamside vegetation with a hydrologic connection to the stream) function as natural environmental filters for sediment and chemicals, provide wildlife habitat, and are often comprised of diverse hydrophytic plant communities. Floodplains for this analysis are 100 year floodplains, the standard for flood hazard analysis.

Table 3.9-1. Streams (WUS), MMPO analysis area.

Stream	Linear Feet
Buckskin Creek and tributary	4,118
Pat Hughes Creek and tributary	4,371
East Fork Pat Hughes Creek	3,971
No Name Creek	7,584
Bruno Creek and tributaries	4,740
West Fork Bruno Creek	1,720
Mill Creek[1]	4,469
TOTAL	**30,973**

[1] Includes the Mill Creek channel in the MMPO footprints and outside of the footprints in the Mill Creek drainage.

3.9.1. MMPO Area and Selected Land

3.9.1.1. MMPO Area

There are 4.65 acres (Alternative M2) and 4.70 acres (Alternative M3) of wetlands in the analysis area (Table 3.9-2., Table 3.9-3., Figure 3.9-1). The USACE has determined that 4.56 acres and 4.60 acres, respectively, of these wetlands are jurisdictional (i.e., regulated by the USACE). The USACE has not made a jurisdictional determination for the remaining 0.09 acre of wetlands, but these wetlands would not be affected by any of the MMPO action alternatives.

The wetlands comprise three Cowardin wetland types:[13] palustrine-forested (PFO), palustrine scrub-shrub (PSS), and palustrine-emergent (PEM) wetlands (Table 3.9-2., Table 3.9-3). Dominant wetland vegetation includes tufted sedge (*Carex lenticularis*), Torrey's rush (*Juncus torreyi*), redtop (*Agrostis stolinifera*), small-wing sedge (*Carex microptera*), leafy aster (*Aster foliaceus*), beaked sedge (*Carex rostrata* [*utriculata*]), Wood's rose, currant, willow, mountain alder (*Alnus incana*), quaking aspen (*Populus tremuloides*), and Engelmann's spruce.

Floodplains were not mapped along streams (WUS) in the MMPO area. Large, lowland rivers that are unconstrained by geology have extensive floodplains; however, smaller mountain streams are often constrained by geology and have narrow floodplains (Gregory et al. 1991). It is assumed that even the smallest streams in the MMPO have floodplains, and most are likely contained within the riparian zone or overlap with jurisdictional wetlands.

Streams in the MMPO are characterized by a riparian zone (a mosaic of riparian herbs, shrubs, and deciduous trees) of varying width and continuity, depending on geomorphic position of the stream and other factors. The most common riparian species observed in the MMPO include cottonwood, aspen, willow, alder, and Douglas-fir. Conifers generally dominate the lower hillslopes.

[13] the standard wetland classification system (Cowardin et al. 1979)

Table 3.9-2. Wetlands, MMPO analysis area (Alternative M2).

Wetland ID	Jurisdiction	Acres	Type[1]	JD[2] Status
BLM W-01	BLM	0.02	PSS	Yes
BLM W-02	BLM	0.01	PEM	Yes
2008 BR	Forest Service	0.12	PFO	Yes
BR2	Forest Service	0.032	PFO	Yes
PH Tributary Spring	BLM	0.05	PEM	Yes
PH1	BLM	0.21	PEM	Yes
WB1	Forest Service	0.025	PFO	Yes
WB2	Forest Service	0.108	PFO	Yes
WBWet1	Forest Service	0.004	PEM	Yes
WBWet2	Forest Service	0.003	PEM	Yes
Wetland1	Forest Service	0.036	PFO	Yes
Power line (PL)	Forest Service	0.06	PFO	Yes
MC1	Private	0.217	PEM	Yes
MC2	BLM and Private	1.03	PEM	Yes
MC3	BLM	0.21	PEM	Yes
MC4[3]	BLM	0.796	PEM	Yes
MC5	BLM and Private	0.14	PEM	Yes
MC6	BLM and Private	0.811	PEM	Yes
MC7	Private	0.153	PEM	Yes
MC8	Private	0.406	PEM	Yes
MC9[3]	Private	0.203	PEM	Yes
MC Spring	Private	0.002	Spring	Yes
TOTAL		**4.65**		

[1] Cowardin et al. (1979)
[2] jurisdictional determination
[3] Wetlands occur both in the MMPO footprints and outside of the footprints in the Mill Creek drainage.

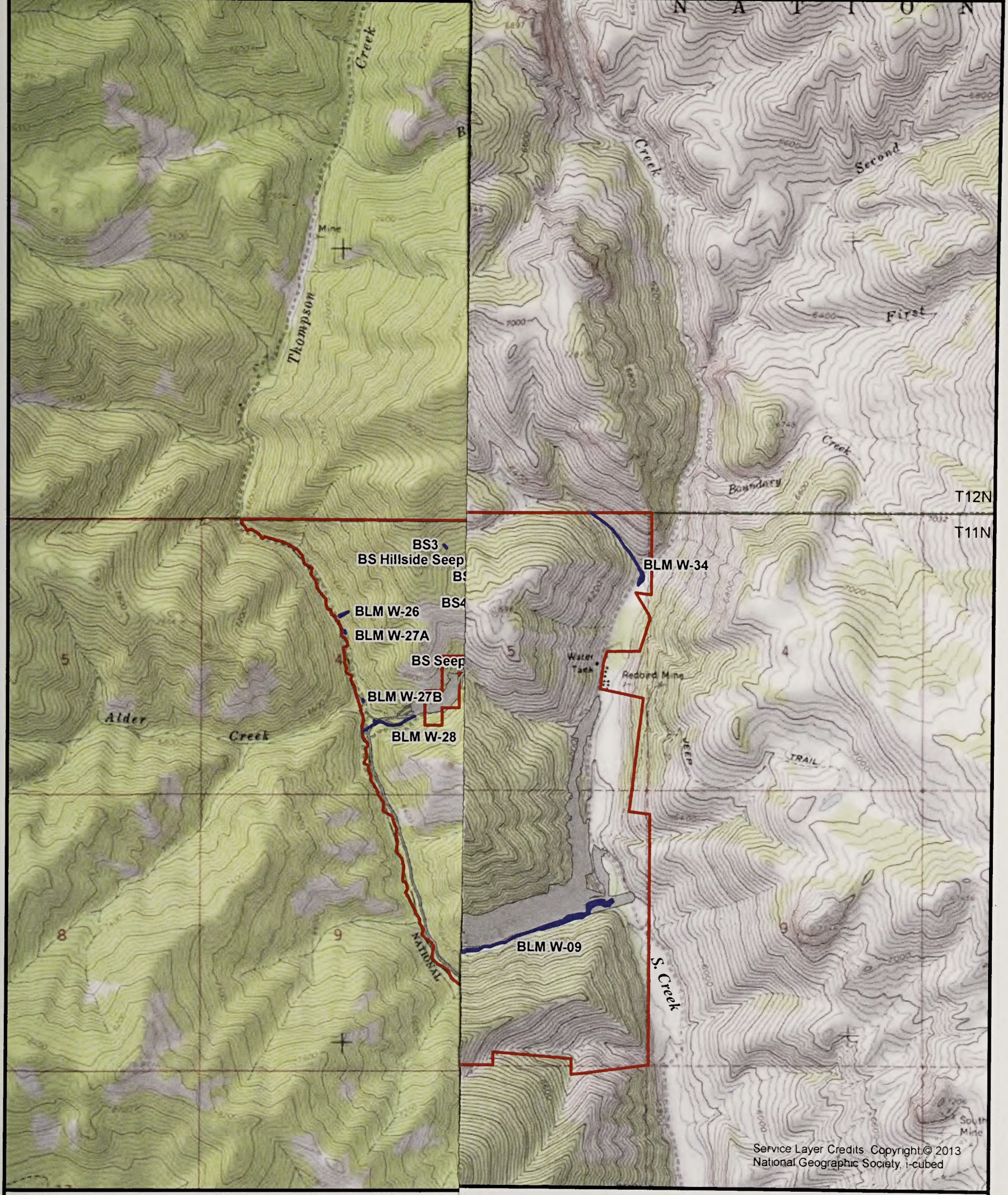
Table 3.9-3. Wetlands, MMPO analysis area (Alternative M3).

Wetland ID	Jurisdiction	Acres	Type[1]	JD[2] Status
BLM W-01	BLM	0.02	PSS	Yes
BLM W-02	BLM	0.01	PEM	Yes
2008 BR	Forest Service	0.12	PFO	Yes
BR2	Forest Service	0.032	PFO	Yes
PH Tributary Spring	BLM	0.05	PEM	Yes
PH1	BLM	0.21	PEM	Yes
UN1	BLM	0.03	PEM	Yes
UN2	BLM	0.02	PEM	Yes
WB1	Forest Service	0.025	PFO	Yes
WB2	Forest Service	0.108	PFO	Yes
WBWet1	Forest Service	0.004	PEM	Yes
WBWet2	Forest Service	0.003	PEM	Yes
Wetland1	Forest Service	0.036	PFO	Yes
Power line (PL)	Forest Service	0.06	PFO	Yes
MC1	Private	0.217	PEM	Yes
MC2	BLM and Private	1.03	PEM	Yes
MC3	BLM	0.21	PEM	Yes
MC4[3]	BLM	0.796	PEM	Yes
MC5	BLM and Private	0.14	PEM	Yes
MC6	BLM and Private	0.811	PEM	Yes
MC7	Private	0.153	PEM	Yes
MC8	Private	0.406	PEM	Yes
MC9[3]	Private	0.203	PEM	Yes
MC Spring	Private	0.002	Spring	Yes
TOTAL		**4.66**		

[1] Cowardin et al. (1979)
[2] jurisdictional determination
[3] Wetlands occur both in the MMPO footprints and outside of the footprints in the Mill Creek drainage.

3.9.1.2. Selected Land

A total of 52 wetlands (49.69 acres) within three Cowardin wetland types (PEM, PSS, and PFO) were identified within the selected land (Table 3.9-4., Figure 3.9-1).



Sciences.

Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Wetlands
- Surveyed stream segments

Figure 3.9-1
Wetlands and streams, MMPO area and selected land
Thompson Creek Mine EIS

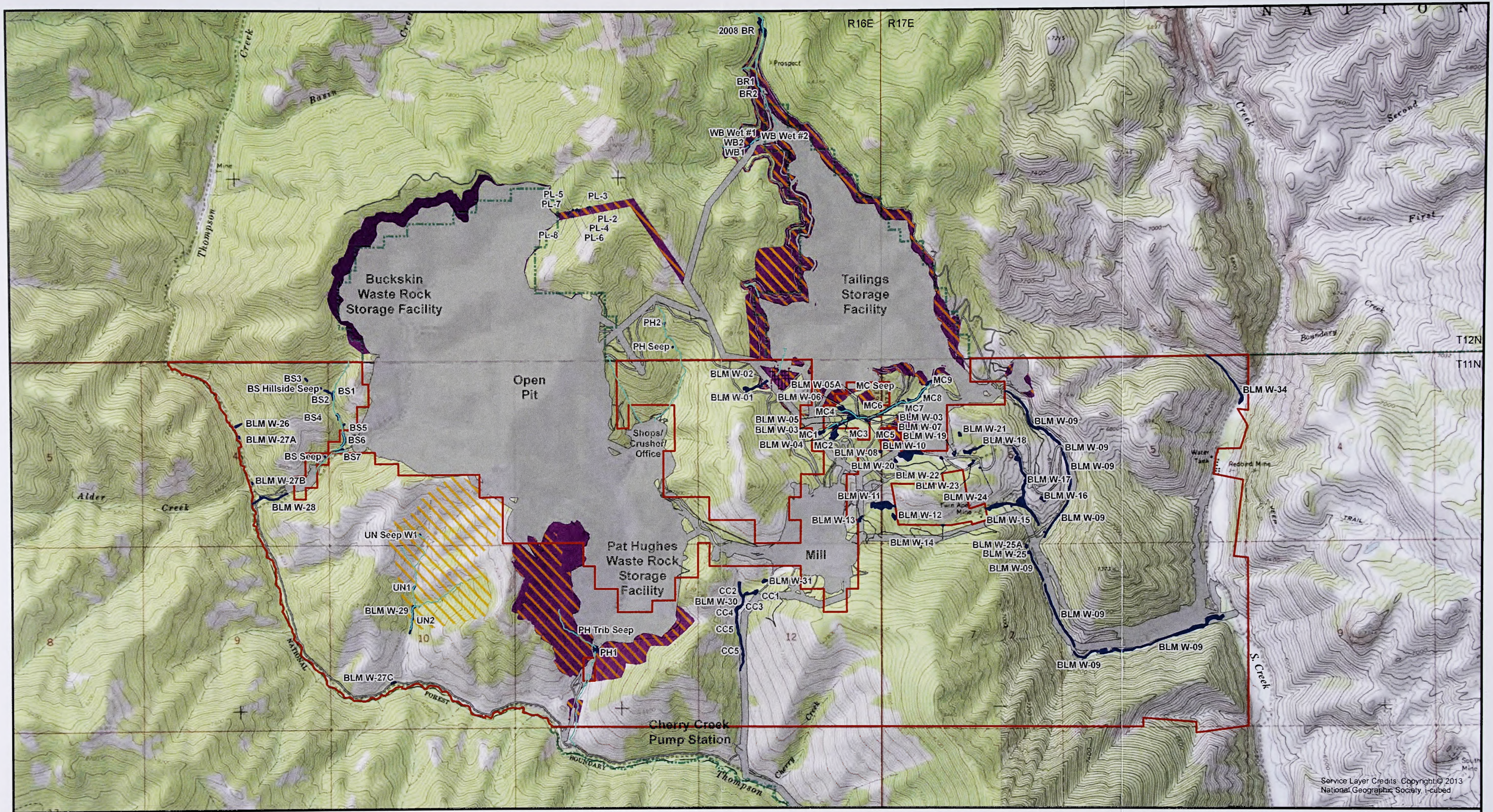
Table 3.9-3. Wetlands, MMPO analysis area (Alternative M3).

Wetland ID	Jurisdiction	Acres	Type[1]	JD[2] Status
BLM W-01	BLM	0.02	PSS	Yes
BLM W-02	BLM	0.01	PEM	Yes
2008 BR	Forest Service	0.12	PFO	Yes
BR2	Forest Service	0.032	PFO	Yes
PH Tributary Spring	BLM	0.05	PEM	Yes
PH1	BLM	0.21	PEM	Yes
UN1	BLM	0.03	PEM	Yes
UN2	BLM	0.02	PEM	Yes
WB1	Forest Service	0.025	PFO	Yes
WB2	Forest Service	0.108	PFO	Yes
WBWet1	Forest Service	0.004	PEM	Yes
WBWet2	Forest Service	0.003	PEM	Yes
Wetland1	Forest Service	0.036	PFO	Yes
Power line (PL)	Forest Service	0.06	PFO	Yes
MC1	Private	0.217	PEM	Yes
MC2	BLM and Private	1.03	PEM	Yes
MC3	BLM	0.21	PEM	Yes
MC4[3]	BLM	0.796	PEM	Yes
MC5	BLM and Private	0.14	PEM	Yes
MC6	BLM and Private	0.811	PEM	Yes
MC7	Private	0.153	PEM	Yes
MC8	Private	0.406	PEM	Yes
MC9[3]	Private	0.203	PEM	Yes
MC Spring	Private	0.002	Spring	Yes
TOTAL		**4.66**		

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Legend

- Selected land
- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Wetlands
- Surveyed stream segments

Land Ownership

- BLM
- Private
- State
- Forest Service

Selected land, existing mining disturbance from Thompson Creek Mine data, polygons created by Ken Gardner.
Ownership data is at 1:24,000 and created and maintained by the Bureau of Land Management, Idaho State Office, Geographic Sciences.
Wetland Data from JBR (HDR) 2008 and 2009
Topographic background from USGS 7.5' Quadrangles 1:24,00 scale.
Coordinate system UTM Zone 11 NAD 83

N

1:32,000

0 1 Miles

0 1 Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.9-1
Wetlands and streams, MMPO area and selected land
Thompson Creek Mine EIS

Note that because all portions of the MMPO area on BLM land overlap the selected land, the area of wetlands at the selected land includes all of the wetlands in the MMPO area previously described (Section 3.9.1.1).

As discussed in Section 3.9.1.1., floodplains were not mapped; however, floodplains of varying width and continuity occur along all streams (WUS) within the selected land, and most are likely contained within the riparian zone or overlap with jurisdictional wetlands.

Table 3.9-4. Wetlands, selected land.

Wetlands[1]						TOTAL	
PEM		PSS		PFO			
#	acre	acre	acre	#	acre	#	acre
30	5.81	19	40.04	3	3.84	**52**	**49.69**

[1] Cowardin et al. (1979)

Well-vegetated riparian areas were observed adjacent to S. Creek, Thompson Creek, and portions of Bruno Creek and Mill Creek. Dominant vegetation species vary by wetland type, and include alder, quaking aspen, cottonwood, red-osier dogwood, willow, rush (*Juncus* spp.), sedge (*Carex* spp.), bluejoint reedgrass, saxifrage (*Saxifraga* spp.), largeleaf avens (*Geum macrophyllum*), and bishop's cap (*Mitella* spp).

In general, the width of the riparian area on these streams varies from a few feet to approximately 50 feet. Buckskin Creek and Pat Hughes Creek support only an intermittent riparian corridor.

As part of the wetland and stream mitigation plan (Appendix A), more detailed information was collected for S. Creek. The riparian corridor along S. Creek is up to approximately 100 feet wide in some locations and is dominated by cottonwood, alder, willow, sedges, rushes, and pasture grasses. The riparian corridor and wetland meadows associated with S. Creek are grazed during the summer months. Both TCMC and the BLM administered land in this corridor for grazing, and some bank sloughing is present in several locations on S. Creek due to both cattle accessing the stream and natural erosion, particularly during high flows.

3.9.1.3. Offered Lands - Broken Wing Ranch

A total of 19 wetlands (36.98 acres) were identified on the Broken Wing Ranch (Table 3.9-5., Figure 3.9-2). Four wetlands are associated with ditches (W-9, W-10, W-11, and W-12) and one wetland is adjacent to the Salmon River (W-8). Cowardin wetland types on the ranch include PSS, PEM, and PFO wetlands. The dominant vegetation in each of the wetland types includes quaking aspen, cottonwood, red-osier dogwood, various willows, various rushes, Nebraska sedge (*Carex nebrascensis*), beaked sedge, Garrison creeping foxtail (*Alopecurus arundinaceus*), redtop, and timothy.

Table 3.9-5. Wetlands, offered lands.

Parcel	Wetlands[1]						TOTAL by Parcel	
	PEM		PSS		PFO			
	#	acre	#	acre	#	acre	#	acre
Broken Wing Ranch	7	26.72	10	8.87	2	1.39	**19**	**36.98**
Garden Creek property	0	0	1	0.7	0	0	**1**	**0.7**
TOTAL	**7**	**26.72**	**11**	**9.57**	**2**	**1.39**	**20**	**37.68**

[1] Cowardin et al. (1979)

The 100 year floodplain for the Salmon River is present in many locations on the ranch (Figure 3.9-3). The river also has a well-developed riparian corridor (generally 5 to 25 feet wide). In some places, grazing has caused substantial trampling and compaction of the riparian area along the Salmon River at the ranch. Lyon and Sink creeks are perennial streams that flow through the ranch. Lyon Creek is a high-gradient stream with a riparian corridor (~ 20 feet wide) in the higher elevation area of the ranch (BWR-1). The riparian corridor on the lower portion of Lyon Creek (except where it is impounded) is well-vegetated but less than 10 feet wide. Sink Creek is an intermittent stream that flows through a pivot-irrigated agricultural field on the ranch. There are no riparian areas on the portion of Sink Creek on the ranch.

3.9.2. Offered Lands - Garden Creek Property

One wetland system (PSS) (0.7 acre) occurs on the north side of the property along Garden Creek (Table 3.9-5). There are no 100 year floodplains on the property. Garden Creek is a small stream with a well vegetated (riparian grasses, sedges and shrubs) riparian corridor less than 20 feet wide on the property.

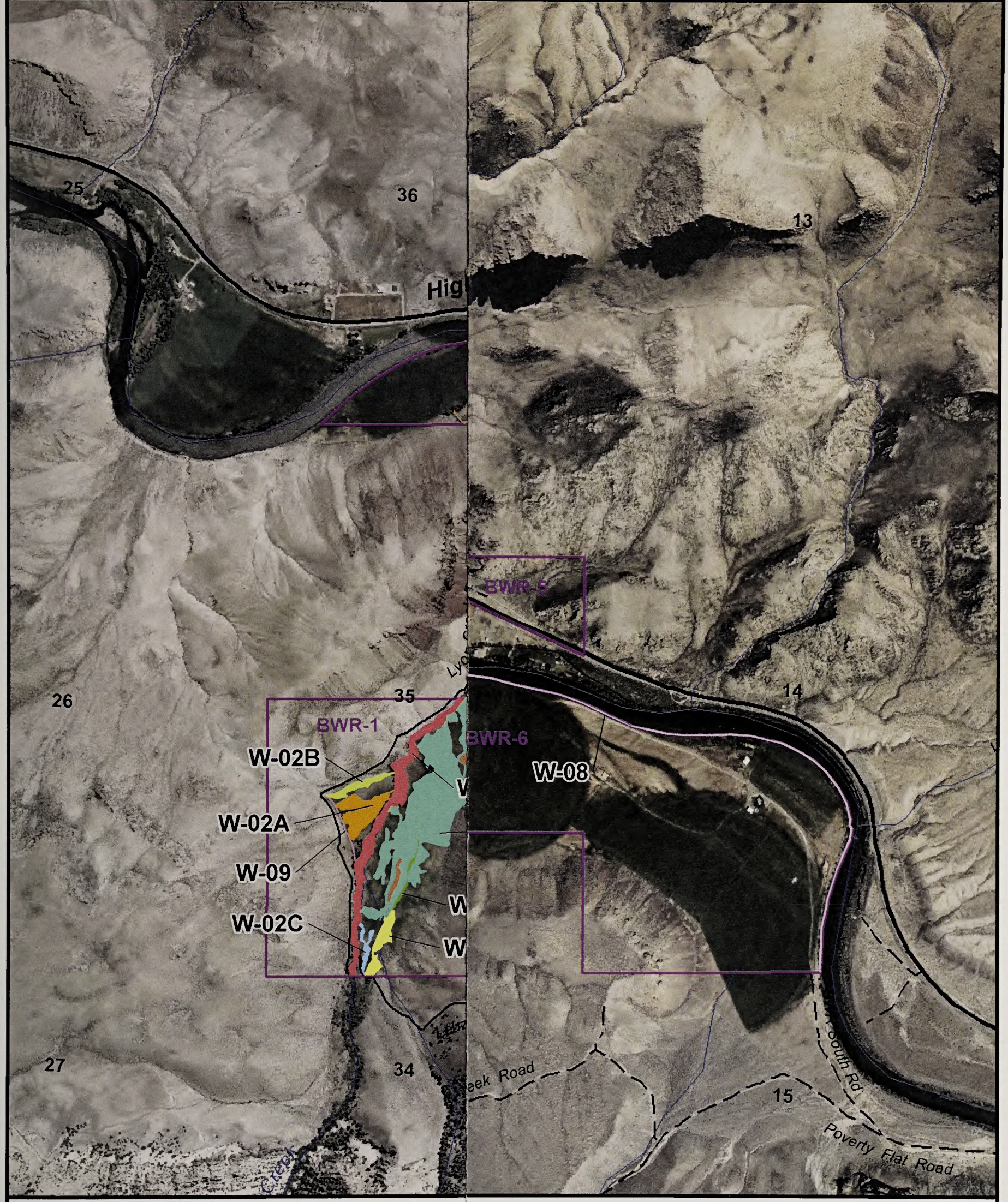


Figure 3.9-2
Wetlands, Broken Wing Ranch
Thompson Creek Mine EIS

Table 3.9-5. Wetlands, offered lands.

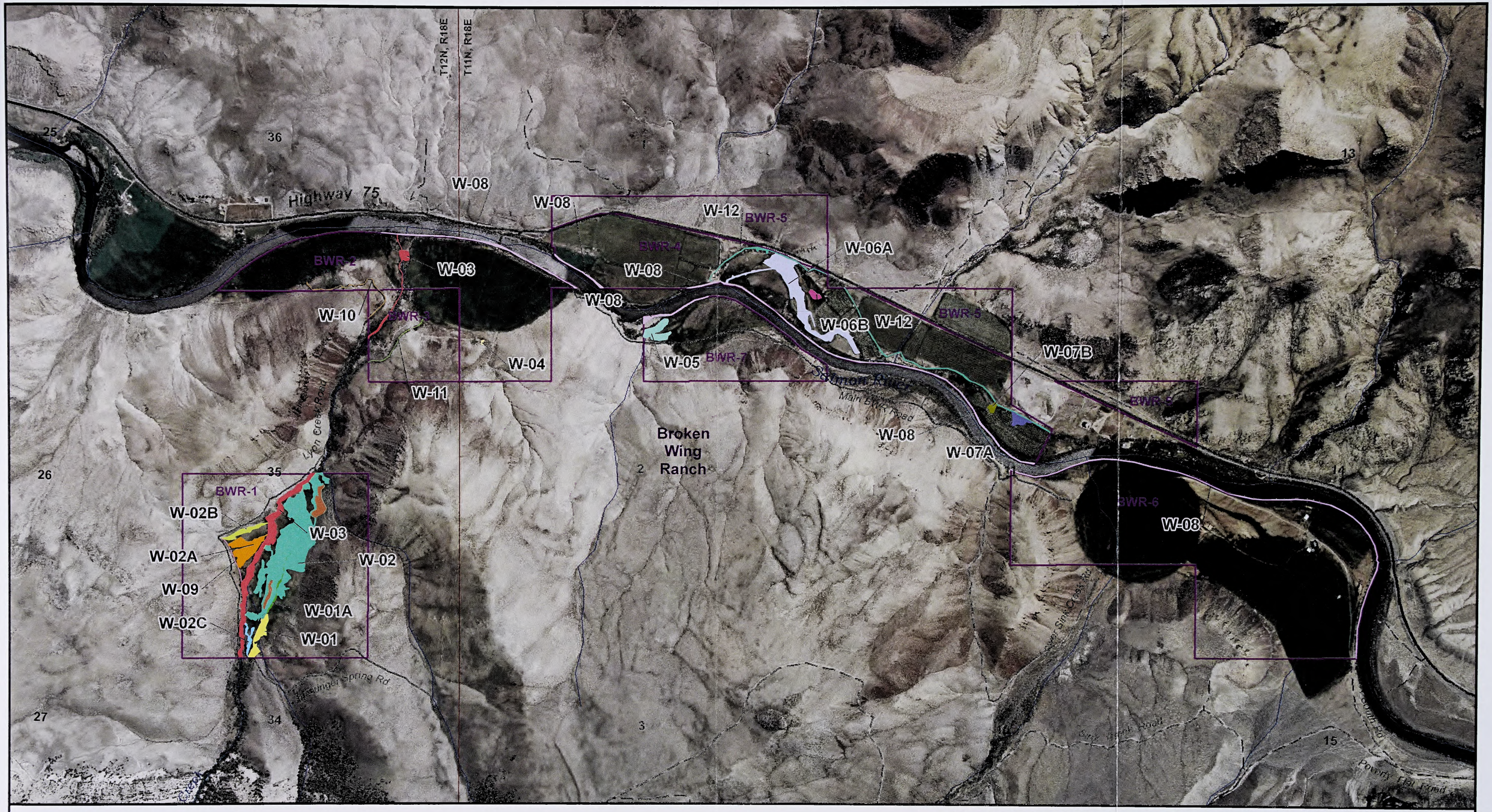
Parcel	Wetlands[1]						TOTAL by Parcel	
	PEM		PSS		PFO			
	#	acre	#	acre	#	acre	#	acre
Broken Wing Ranch	7	26.72	10	8.87	2	1.39	**19**	**36.98**
Garden Creek property	0	0	1	0.7	0	0	**1**	**0.7**
TOTAL	**7**	**26.72**	**11**	**9.57**	**2**	**1.39**	**20**	**37.68**

[1] Cowardin et al. (1979)

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Legend

- Offered lands
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream

Wetlands

- BW W-01
- BW W-01A
- BW W-02
- BW W-02A
- BW W-02B
- BW W-02C
- BW W-03
- BW W-04
- BW W-05
- BW W-06A
- BW W-06B
- BW W-07A
- BW W-07B
- BW W-08
- BW W-09
- BW W-10
- BW W-11
- BW W-12
- UPLAND

Wetland data from Atkins 2010
2009 NAIP Imagery
Coordinate system UTM Zone 11 NAD 83

N

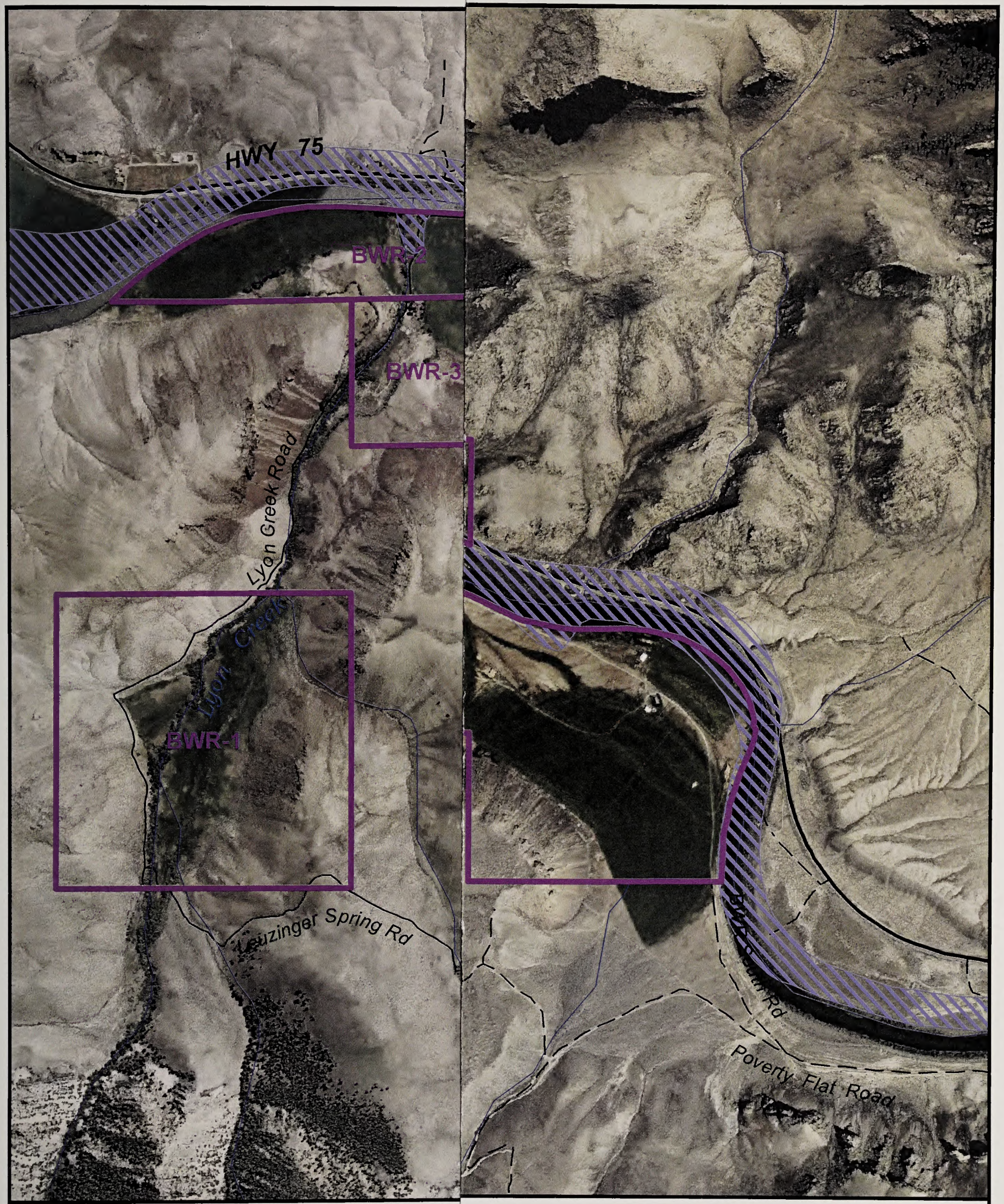
1:16,000

1,600 0 1,600
Feet

500 0 500
Meters

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

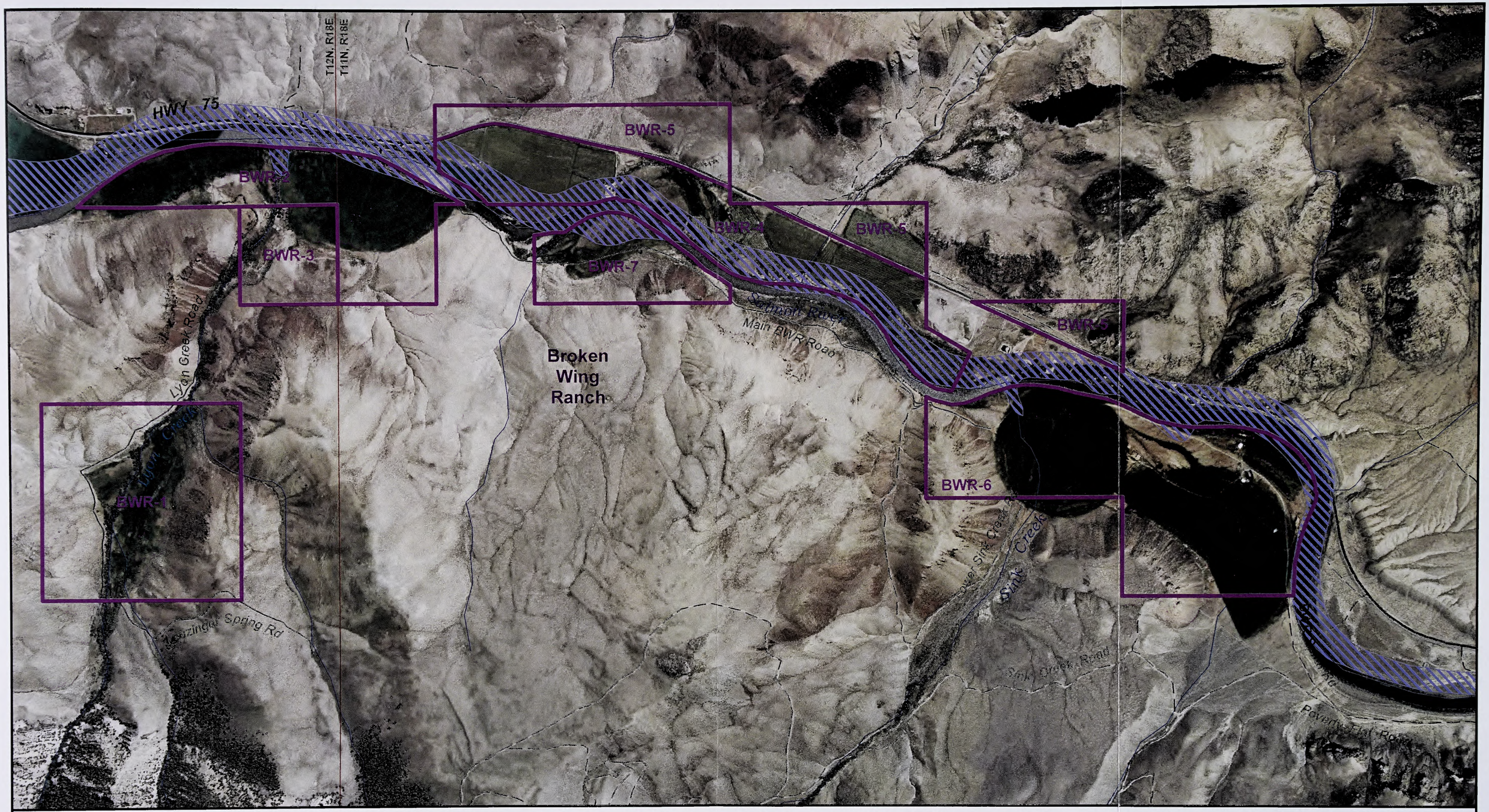
Figure 3.9-2
Wetlands, Broken Wing Ranch
Thompson Creek Mine EIS



Legend

- Broken Wing Ranch NEPA parcels
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- Special flood hazard areas (100-year floodplain)

Figure 3.9-3
Floodplains, Broken Wing Ranch
Thompson Creek Mine EIS



Legend

- Broken Wing Ranch NEPA parcels
- Main Broken Wing Ranch access
- 2WD road (Highway 75)
- Primitive road
- Stream
- Special flood hazard areas (100-year floodplain)

Flood data from Federal Emergency Management Agency (1998).
2009 NAIP Imagery

N

0 1:15,000 2,500
Feet

0 0.75
Kilometers

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.9-3
Floodplains, Broken Wing Ranch
Thompson Creek Mine EIS

3.10. Air Quality, Noise, and Climate Change

The analysis area for air quality and noise for the MMPO alternatives is 1) a circle with a radius of 4 miles centered at the mine (26,870 acres), and 2) the primary access roads to the mine. The analysis area for climate for the MMPO alternatives is the mine site. The analysis area for the land disposal alternatives for air quality, noise, and climate is the selected and offered lands, and also any residents living within 1,000 feet of the offered lands. The analysis area for climate change is the mine, Idaho, the Northern Rocky Mountain region, the US, and the world.

3.10.1. Regulatory Framework

3.10.1.1. Air Quality

The Clean Air Act requires the EPA to establish National Ambient Air Quality Standards (NAAQS) for certain air pollutants to protect public health (primary standards) and public welfare (secondary standards). To date the EPA has established NAAQS for six "criteria" pollutants: nitrogen oxides (NO_x), sulfur oxides (SO_x), particulate matter (PM subdivided into $PM_{2.5}$ and PM_{10}), carbon monoxide (CO), ozone (O_3) and lead (Pb) (Table 3.10-1.)[14] (EPA 2012a). Compliance with these NAAQS in Idaho is regulated by the IDEQ (IDEQ 2012a). Significant Impact Levels (SILs) are discussed below.

Four AQCRs (part of the Idaho State Implementation Plan) have been designated in Idaho for the purpose of monitoring and maintaining air quality (40 CFR 81.313). The analysis areas for the MMPO area, selected land, and Broken Wing Ranch are in AQCR 63. The Garden Creek property is in AQCR 61. All of the analysis areas are in locations the EPA has determined as *unclassifiable/attainment* (40 CFR 81.313).

The Clean Air Act also established a three-tier area classification scheme (Class I, Class II and Class III areas) to prevent significant deterioration of air quality. Class I areas have special natural, scenic, recreational or historic value. There are currently 156 Class I areas comprising national parks greater than 6,000 acres, wilderness areas greater than 5,000 acres, and the Roosevelt-Campobello International Park in Maine and Canada (EPA 2012b). All other areas are Class II as no Class III areas have been designated. The analysis areas are all in areas with the Class II designation.

Prevention of significant deterioration (PSD) regulations (40 CFR 52.21) apply to new major stationary sources or major modifications to existing sources for pollutants when the area in which the source is located is designated as *unclassifiable/attainment* (EPA 2012c). These regulations specify the maximum allowable increases of pollutants in the classified areas from a baseline condition for each pollutant; moderate increases are allowed in Class II areas. The PSD regulations also define SILs: de minimis thresholds (as opposed to significant NEPA effects) applied to individual facilities that apply for a permit to emit a regulated pollutant in an area that meets the NAAQS. The SILs are measures of whether a source may cause or contribute to a violation of a PSD increment or the NAAQS, i.e., a meaningful deterioration of air quality (EPA 2012d).

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[14] the standards are for NO_2 and SO_2 which represent NO_x and SO_x, respectively

New source performance standards, also required under the Clean Air Act, are set by the EPA for metallic mineral processing plants such as the crusher and mill at the mine site that are stationary sources of air pollutants. Also pursuant to the Clean Air Act, the EPA has established a series of emissions limits (Tier 1 through Tier 4) for non-road diesel engines and sulfur limits in diesel fuel that apply to portions of mine operations.

Table 3.10-1. Criteria pollutant standards for SILs and NAAQS.

Pollutant	Effects to Humans	Averaging Period	Class II SIL[1] ($\mu g/m^3$)	Primary NAAQSs ($\mu g/m^3$)[2]
CO	can limit oxygen intake	8 hours	500	10,000[3]
		1 hour	2,000	40,000[3]
Pb	toxic at low exposure	quarterly	none	1.5
		rolling 3 month avg.	0.03[4]	0.15
NO_2	pungent, irritating effect	1 hour	7.5[4]	188.7[5]
		annual	1	100
O_3	adversely affects respiratory system	1 hour	none	235[6]
		8 hours	none	146.9[7]
PM_{10}	can pass into respiratory system	24 hours	5	150[8]
$PM_{2.5}$	can pass into respiratory system	annual	0.3	12[9]
		24 hours	1.2	35[10]
SO_2	can reduce lung function	1 hour	10[4]	196[11]

EPA (2012a)
[1] 40 CFR 51.165(b)(2) except as noted
[2] converted to $\mu g/m^3$ for consistency
[3] not to be exceeded more than once per calendar year
[4] based on interim EPA guidance
[5] To attain this standard the 3 year average of the 98th percentile of the daily maximum 1 hour average at each monitor in an area must not exceed 100 parts per billion (ppb) (effective 22 January 2010).
[6] not to be exceeded more than once per calendar year
[7] 3 year average of 4th maximum
[8] not to be exceeded more than once per year on average over 3 years
[9] 3 year weighted average; reduced from 15 micrograms per cubic meter ($\mu g/m^3$) on 14 December 2012
[10] 3 year average of annual 98th percentile value
[11] Final rule signed 02 June 2010. To attain this standard the 3 year average of the 99th percentile of the daily maximum 1 hour average at each monitor in an area must not exceed 75 ppb.

Air quality permit requirements

The PSD regulations set PSD permitting de minimis conformity thresholds by which stationary sources of criteria air pollutants are classified as major or minor. A Title V (Tier 1) operating

permit is required for any stationary source classified as *major*. A Tier II operating permit is required for most stationary sources classified as *minor*. The mine is currently permitted under a Tier II operating permit and is considered a Title V synthetic minor source because its stationary emissions do not reach any of the major thresholds with required emission controls, but would reach one or more of the thresholds without the emission controls (IDEQ 2012b).

Tier II operating permits are administered in Idaho by the IDEQ, which is responsible for reviewing proposed new or modified industrial activities and reviewing the permits every five years. The current (facility-wide) Tier II operating permit (P-2008.0159) for the mine was issued by the IDEQ on 27 January 2009. The permit includes requirements for baghouses to control dust on seven processes including crushers, bins, and transfer points, and wet scrubbers other processes including ore feeders, three dryers, and the leach plant. The permitted emissions are well below the PSD permitting de minimis conformity thresholds for a major source (IDEQ 2009a, 2009b, 2012c).

The Rules for the Control of Air Pollution in Idaho (IDAPA 58.01.01) define State air pollution control requirements. Applicable requirements for the mine, which incorporate Federal air authority EPA requirements, include that all reasonable precautions be taken to prevent PM from becoming airborne (IDAPA 58.01.01.651), and a prohibition on the discharge of any air pollutant into the atmosphere from any point of emission for a period or periods aggregating more than 3 minutes in any 60 minute period with an opacity greater than 20 percent (IDAPA 58.01.01.625).

Other air quality permits associated with the mine

Most of the molybdenum concentrate from the mine is converted from molybdenum sulfide to molybdenum trioxide at the Thompson Creek Metals Company (parent company of TCMC) roasting facility in Langeloth, Pennsylvania. The facility operates under a Title V operating permit issued by the Pennsylvania Department of Environmental Protection that limits facility-wide emissions of all criteria pollutants to less than 250 tons per year. Emissions from the Langeloth facility during 2008 to 2010 averaged 88.8 tons per year of sulfur dioxide, and less than 10 tons per year of all other criteria air pollutants. However, because the molybdenum concentrate from the mine could be roasted at other facilities in the US with different emissions, the Langeloth facility is not evaluated in this EIS.

3.10.1.2. Noise Levels

There are no noise standards (State, county, city) applicable to the MMPO and land disposal alternatives other than general nuisance laws (52 Idaho Statutes 101 *et seq.*) and vehicle noise abatement laws (e.g., 67 Idaho Statutes 7125).

MSHA regulations require a mine operator to assure that no miner is exposed during any work shift to noise that exceeds the permissible instantaneous exposure level of 115 A-weighted decibels (dBA), or an 8 hour time-weighted average sound level (TWA_8) of 85 dBA (or equivalently a dose of 50 percent, integrating all sound levels from 80 dBA to at least 130 dBA) (30 CFR 62.130).

3.10.2. Climate Overview

This section provides a general discussion of climate applicable to all of the analysis areas, with site-specific climate information subsequently provided for each analysis area. Additional precipitation data as well as evaporation data is also provided for the mine site in the water resources section (Section 3.6.).

The air flow over central and southeastern Idaho is predominantly westerly bringing maritime air from the Pacific Ocean to the region (480 miles to the mine and 620 miles to the Garden Creek property), with local variations due to elevation, topography (e.g., canyon winds), and vegetation. For example, coastal mountain ranges act as a natural barrier to the moist maritime air and create a rain shadow resulting in relatively low precipitation over the region. In addition, mountainous terrain breaks up and weakens winter storms in the regions, which generally results in a dry and cool to cold continental climate. However, mountainous terrain also channels wind and sometimes blocks or intensifies passing weather systems.

The climate is characterized by long winters generally persisting from November through April, and short, hot, dry summers. The regions receive their most intense precipitation in late spring. In the summer, moisture-laden air occasionally arrives from the south (Gulf of Mexico and Caribbean) at high levels to produce thunderstorm activity in high-intensity, short-duration (< 1 hour) events (WRCC 2012).

Summer thunderstorms provide measurable moisture, but the summer climate is generally characterized by low (< 25 %) relative humidity and abundant sunshine. A dry fall season is typical, and can extend into December. Winds may blow in all directions, but mountain-valley wind patterns are prevalent, i.e., colder air rises upslope in the mornings and the reverse in the evenings. Idaho has no destructive storms such as hurricanes, and an extremely small incidence of tornadoes. Windstorms associated with cyclonic systems, and their cold fronts, do some damage to trees each year, but only minor damage to structures in Idaho. Such storms may occur from October to July. The highest wind velocities occur during summer thunderstorms, which have the greatest incidence in Idaho in mountainous areas, where lightning often causes wildfires (WRCC 2012). However, the dominant cause of wildfires in the regions is humans.

Smoke haze from wildfires or prescribed fires may occur for a few days in the regions several times during the spring and summer months when forests or agricultural lands are burning locally. Smoke haze generally persists for a few days to several weeks when smoke is carried by prevailing winds to the region from large wildfires in Idaho, Montana, Nevada, or California (BLM 1998). However, such smoke haze persisted during August and September 2012 due to the Halsted wildfire (181,798 acres) west of Challis (USFS 2012a). The smoke haze was most distinct during the evenings, and caused elevated 24 hour $PM_{2.5}$ concentrations of 20 to 90 $\mu g/m^3$, and as high as 146 $\mu g/m^3$ (USFS 2012b). A general area of smoke haze throughout cities and downwind plumes from scattered rural residences are common during winter due to the burning of wood for heating. For example, the 24 hour $PM_{2.5}$ concentrations in Salmon are typically 3 to 6 $\mu g/m^3$ during the spring and 20 to 30 $\mu g/m^3$ during the winter (IDEQ 2013). Dust pollution can be locally quite severe on more frequently traveled unpaved roads. However, such dust pollution is rapidly dispersed by prevailing winds (BLM 1998).

3.10.3. MMPO Area and Selected Land

3.10.3.1. Climate

The analysis area is relatively dry with wide daily and monthly variations in temperature. The highest average monthly maximum temperatures in the area during the period from 1971 to 2000 ranged from 70 °F at the higher elevations to 82 °F at the lower elevations, and occurred in July and August. The average daily maximum temperatures were below freezing at the upper elevations in December and January, but rarely below freezing at the lower elevations. The lowest average monthly minimum temperatures during that period ranged from 5 °F at the lower elevations to 9 °F at the higher elevations, and occurred in January and February (PRISM 2006a, 2006b, TCMC 2010b). A temperature inversion of 2 to 4 °F is typical on the coldest days in January, September, and December. The average daily minimum temperatures were below freezing at all upper elevations by October and remained below freezing at the lower elevations through April and at the upper elevations through May.

The average annual precipitation during the period from 1971 to 2000 at the analysis area ranged from 15.5 inches at the lower elevations to 26.0 inches at the higher elevations with an average annual precipitation of 20.7 inches. At the lower elevations, approximately 1 inch fell each month except for approximately 2 inches in May and in June. At the higher elevations, 1.8 inches fell each month except for approximately 3.5 inches in May and June (PRISM 2006c). Thunderstorms are predominant in late spring and occasionally through the summer. Approximately 70 percent of the precipitation in the area falls as snow (October through March). From 1961 to 1990 the area received an average annual snowfall of 65 inches at the lower elevations and 129 inches at the higher elevations. Most of the snowfall was during November to March, with lesser amounts falling April to June and in October (PRISM 2000). Avalanches can occur on the steeper slopes during the winter (VTN 1980a).

Winds in the analysis area are generally from the west with daily velocities generally highest in the evenings and just prior to dawn. The area displays typical mountain-valley wind patterns. The average monthly wind velocities are lowest during May through September (2 to 7 miles per hour [mph]) and highest during October through April (9 to 12 mph), with an average annual wind velocity of 8 mph (ICBEMP 1997a). The average highest wind velocity annually for the region is 45 mph, with an average annual occurrence of four peak gusts greater than or equal to 50 mph (NCDC 2002). Two regional extreme wind events that occurred in January 1990 and January 1993 were both from the south. However, these events produced wind velocities of up to only 19.9 mph at the analysis area (ICBEMP 1997b). Extreme wind velocities due to thunderstorms and wind channeling along local topographic features are probably less than 67 mph, based on the NCDC data and a peak gust of 44 mph at the Bonanza weather station 11 miles to the west-northwest (WRCC 2011a). The locality receives approximately 40 lightning strikes per 62 square miles per year (ICBEMP 1997c).

3.10.3.2. Air Quality

The air quality of the analysis area is primarily influenced by regional (as opposed to mine-related) vehicle emissions and PM from wildfires, prescribed fires, burning wood for space heating, agriculture and ranching activities, recreational activities, and natural wind erosion. However, the relevant sources of mine-related criteria pollutants for the analysis area are mine-

related highway traffic, on-site traffic, on-site stationary sources, and, in the case of PM, various non-point sources. The emissions from these mine-related sources are provided below, along with the concentrations of the relevant three criteria pollutants for ambient air at the mine perimeter. Also provided are current background (non-mining) concentrations of criteria pollutants, and the concentrations of these pollutants at the nearest sensitive receptor. There is no discussion of Pb which is not emitted in meaningful quantities related to the mine. In addition, the relatively small amounts of nitrogen dioxide and volatile organic compounds (VOCs) related to the mine preclude the generation of meaningful ground-level ozone related to the mine.

The annual contributions of carbon dioxide and NO_2 (there was no meaningful sulfur dioxide, PM or VOCs) from mine-related highway traffic were calculated as 36.5 and 3.65 tons, respectively, and determined to have no meaningful effect to air quality (VTN 1980d). More recent calculations of the current annual emissions from this traffic (commuter and vendor traffic as well as concentrate shipments to Pennsylvania) are approximately 100 tons CO, 13 tons NO_2, 81 tons PM_{10} (3.5 tons from exhaust, 77.5 tons from fugitive dust), 1 ton SO_2, and 23 tons VOCs (TCMC 2012c).

The current annual emissions from on-site traffic (e.g., haul trucks and pickup trucks) are approximately 250 tons carbon monoxide, 800 tons nitrogen oxides, 450 tons PM_{10} (49.5 tons from exhaust as $PM_{2.5}$, 386.6 tons from fugitive dust as mostly coarse PM_{10}), 0.2 tons sulfur dioxide, and 80 tons VOCs. The annual emissions from on-site stationary sources are 21.2 tons carbon monoxide, 86.8 tons nitrogen dioxide, 20.8 tons PM_{10}, 21.2 tons sulfur dioxide, 7.54 tons VOCs, a maximum potential single hazardous air pollutant (HAP) of 5.58 tons (total organic carbon), and a maximum potential combined HAPs of 5.59 tons (total organic carbon plus metals) (Doughty 2012, IDEQ 2012c).

Unlike many areas in the US, central and southeast Idaho have distinct wet and dry seasons. During the dry season much of the soil is prone to yielding fugitive dust, particularly in areas with high winds or frequent surface disturbance. The primary sources of fugitive dust in the analysis area include ground disturbing activities at the mine (e.g., drilling, blasting, ore and waste rock haulage, waste rock disposal, tailings management), as well as general vehicle traffic on unpaved roads, local and regional wildfires, plowed fields, and all of the natural ground with relatively fine soil and sparse vegetation.

Fugitive dust controls employed by TCMC currently include speed limits, water sprayed from water trucks, and magnesium chloride applications. In addition, most of the haul roads have relatively low (~ 3 %) silt content from many years of use. These and other factors mean the current annual emissions of PM_{10} and $PM_{2.5}$ from the mine during molybdenum production are approximately 1,980 tons and 290 tons, respectively.

The only criteria pollutants from stationary sources of potential concern to ambient air quality (the perimeter of the mine) are PM_{10}, sulfur dioxide, and nitrogen dioxide. However, the contributions of these pollutants from stationary sources at the mine would not cause the concentrations of these pollutants in the ambient air to be greater than any of the primary NAAQSs (IDEQ 2012c).

Non-point sources (e.g., mobile sources) of PM_{10}, SO_2, and NO_2 are too small and too widely distributed to meaningfully contribute to the concentrations of these pollutants from stationary sources in ambient air. Regardless, the concentration of each criterion pollutant from the combined emissions (non-point and stationary) at the mine were calculated (Table 3.10-2.) for the nearest sensitive receptor in the analysis area – the few (~ 2 to 4) people that occupy a cabin for a few weeks during the summer on the Redbird property (Section 3.10.3.4). The cabin is 3.0 miles east of the center of the mine site. Note that the calculated concentrations are highly conservative, e.g., it was assumed that all pollutants from all non-point and stationary sources at the mine are concentrated in a single narrow plume directed at the receptor with no topographic shielding.

Table 3.10-2. Criteria pollutants, MMPO area and selected land.

Pollutant	Averaging Period	Background ($\mu g/m^3$)	Sensitive Receptor ($\mu g/m^3$)
CO	1 hour	NA	1.74
	8 hour	200[1]	0.61
NO_2	1 hour	0.5	5.68
	annual	≤ 2	0.061
PM_{10}	24 hours	6 to 10	2.59
$PM_{2.5}$	24 hours	5	0.38
	annual	3	0.02
SO_2	1 hour	3 to 7	0.137

[1] average annual concentration; the 8 hour maximum would be even greater

3.10.3.3. Noise

The metric typically used to measure the "strength" of a sound wave in noise analysis is (effective) sound pressure level (SPL or L_P). The SPL is a relative measure dependent on the environment of the source and receptor of a sound wave. The SPL is typically expressed in decibels (dB) on a logarithmic scale of 0 dB to 194 dB, for which every increase of 10 dB is equivalent to an increase in sound level by a factor of 10. The base of the scale corresponds to 20 µPa (micropascals), the threshold of average human hearing, and the range of sounds in normal human experience is 0 to 140 dB (Table 3.10-3). A 3 dB change is barely perceptible, a 5 dB change is clearly perceptible, and a 10 dB change is perceived as being twice or half as loud (CERES 1996); changes less than 5 dB are generally insignificant (EPA 1974).

Low frequency sound (10 to 200 Hz) becomes dominant over large distances as higher frequency sound is preferentially attenuated. Mining equipment is a noted source of low-frequency sound (BHP 2008, Roberts 2004). In general, constant sounds are less noticeable than irregular or periodic sounds.

The SPL diminishes due to distance from its source, topographic reflection or blocking, atmospheric absorption, ground absorption and foliage absorption. For example, sound waves

can be completely blocked from a receptor in places in the analysis area by topography. More specifically, the mine is at higher elevations than any residences in the area, and is completely surrounded by a series of ridges and valleys. In addition, as sound waves travel down a canyon they are reflected and scattered when they encounter the canyon walls. The analysis area is comprised of steep-walled canyons that surround the mine. These canyons form an irregular pattern such that much of the sound reflected off one canyon wall would encounter reflections off another canyon wall. This back scatter would cause a large overall attenuation in the SPL, but with some amplification in any particular valley by the valley walls. Moreover, sound waves are also distinctly absorbed (e.g., 60 dBA/1,000 feet for 4,000 hertz (Hz) in dense evergreen forest) on contact with foliage and by repeated scattering by tree trunks and limbs (VTN 1980e). Therefore, the sounds of even the loudest equipment (gyratory crusher, 116 dBA) (VTN 1980e) are not audible off the mine site, and sounds of individual vehicles on roads (e.g., heavy trucks at 84 to 86 dBA at 50 feet) are not audible at a distance of 1,000 feet.

Table 3.10-3. Sound levels-thresholds associated with ordinary sound sources.

Source-effect Level	(dBA)	Subjective Description
Loudest sound possible	194	deafening
Death of hearing tissue	180	deafening
12 gauge shotgun blast	165	deafening
Short-term exposure may cause permanent damage	140	deafening
Level at which pain begins; ambulance	125	deafening
Commercial jet take-off at 200 feet; average snowmobile	120	deafening
Sandblasting	115	deafening
Thunder; chainsaw	110	deafening
Road construction jackhammer	100	very loud
Sustained exposure may result in hearing loss	90-95	very loud
Busy urban street	90	very loud
MSHA 8 hour exposure permissible exposure limit	85-90	loud – to very loud
Telephone dial tone; busy street	80	loud
Construction equipment at 50 feet	75-80	loud
Freeway traffic at 50 feet	70	loud
Sound mitigation level for residential areas	67	loud
Normal conversation at 3 to 6 feet	60-65	moderate
Sound mitigation level for undisturbed land	57	moderate
Typical office (interior)	50	moderate
Typical residence (interior); whisper in library at 6 feet	30	faint
Threshold of average human hearing	0	very faint

Chepesiuk (2005), FHA (2006), BBA (2009), EPA (2009a), Galen Carol Audio (2012)

Outdoor SPLs of less than 55 dBA L_{DN}[15] are desirable to protect against speech interference and sleep disturbance for residential areas and areas with educational and healthcare facilities. The value is based on an indoor limit of 45 dBA L_{DN} with an outdoor to indoor reduction of 15 dBA and a 5 dBA safety margin. Outdoor sound levels are as low as 20 to 30 dBA L_{DN} in quiet wilderness areas, with levels typically of 40 dBA L_{DN} in rural residential areas, and levels as high as 85 to 90 dBA L_{DN} in noisy urban areas. Most people in urban areas experience outdoor sound levels of 43 to 72 dBA L_{DN} with a median value of 59 dBA L_{DN}. Most people in rural or non-urban areas experience outdoor sound levels of 35 to 50 dBA L_{DN} (EPA 1974). Some people have difficulty falling asleep at indoor sound levels of 40 to 50 dBA L_{DN}, and there is a 30 to 60 percent probability of people being awakened by a peak sound level of 70 dBA L_{DN} (EPA 1974). The US Department of Housing and Urban Development regulations specify that sites are acceptable for residential use if exposed to outdoor sound levels not exceeding 65 dBA L_{DN}, normally unacceptable if exposed to outdoor levels of more than 65 but not exceeding 75 dBA L_{DN}, and unacceptable if exposed to outdoor levels of more than 75 dBA L_{DN} (24 CFR 51.103).

No known sound level data has been collected in the ambient (non-mining) portion of the analysis area. However, background (pre-mining) sound levels for the Idaho Cobalt project, 58 miles north of the analysis area, were determined from two measurements near the Idaho Cobalt project: 34 dBA equivalent continuous noise level (L_{EQ}) (~ 32 dBA L_{DN}) and 48 dBA L_{EQ} (~ 54 dBA L_{DN}), with the higher value due to flowing water very near the measurement station. Apart from water, the primary sound sources were birds, insects, and wind (USFS 2008a). The Idaho Cobalt project also had recreational, noise-sensitive receptors, and is in an environment very similar to that of the analysis area. Therefore, the pre-mining sound levels in the analysis area were probably approximately 35 dBA L_{DN} except for particular isolated areas and areas near flowing water, the Thompson Creek Road, or the S. Creek Road.

The main sources of sound in the analysis area are ambient conditions (wind, flowing water, birds, insects), and, at the mine, the additional sound from heavy equipment and blasting. The stationary equipment at the mine typically generates 98 to 113 dBA L_{EQ} at 50 feet (VTN 1980e), except all of this equipment is contained in structures (e.g., conveyor, ball mills) or buried in the ground (i.e., gyratory crusher) so that sound levels are below 80 dBA L_{EQ} outside of structures at the mine. All of the mobile heavy equipment at the mine produces sound levels below 90 dBA L_{EQ} or L_{max} at 50 feet (Table 3.10-4). Workers are very rarely within 50 feet of this equipment, except for equipment operators who are inside closed-cabs in which all equipment sound levels are below 80 dBA, e.g., Caterpillar 160M grader cab sound level is 70 dBA with the hydraulic fan at maximum speed (Caterpillar 2012). Commercial air flights do not typically generate sound in the analysis area, but low-flying private aircraft or military jets may be heard a few times a year in the analysis area.

Blasting has occurred regularly at the mine since 1980 and people do not notice blasting vibrations or blasting sound (low rumble, dull "thud") off the mine site. For example, vibrations from only the largest blasts are faintly perceptible to people at the administration building, and are not perceptible to people at the bases of the WRSFs or in the Thompson Creek drainage. The

[15] L_{DN} is the equivalent day-night sound level for a 24 hour period with 10 dBA added to the sound levels during 10 PM to 7 AM. L_{EQ} is the equivalent steady sound level of pressure measured over a period of time.

low rumble of even the largest blasts is rarely noticed by employees on the mine site, and is less audible than the general sound from much of the heavy equipment (e.g., engines, drilling, back-up signals, metal-on-rock scraping, etc.) (Doughty 2012, Natoli 2012). The increase in the SPL 50 feet from SH 75 from mine-related, highway traffic during molybdenum production was estimated at 1.8 dBA (VTN 1980e).

Sound levels at the mine vary from approximately 35 dBA L_{DN} (e.g., the north end of the TSF) to 105 dBA L_{DN} in certain noisy work areas (e.g., the operator position for the gyratory crusher) (VTN 1980e). Sound levels in the ambient portion of the analysis area (more than 1,000 feet or only a few hundred feet where trees are abundant from the mine) are equivalent to pre-mining levels, e.g., approximately 30 dBA L_{DN} in the quietest areas and up to approximately 55 dBA L_{DN} in areas near flowing water.

Table 3.10-4. Typical sound level of selected mining equipment/operations.

Source	Maximum Sound Level (L_{max}) at 50 feet (dBA)
Blasting	94[1]
Bulldozer, Caterpillar D9	85-87
Bulldozer, Caterpillar D11	82[2]
Backhoe	85
Front end loader, Caterpillar 966	77-85
Haul truck, 170 ton	88
Haul truck, 195 ton, Caterpillar 789C	81[2]
Grader, Caterpillar 16H	85 (81)[2]
Pick-up truck	75
Water truck, Caterpillar 777	82[2]
Blast hole (rock) drill	85[1] (82)[2]

VTN (1980e), FHA (2006), Warrior et al. (2006), BHP (2008)

[1] typical contract limit, i.e., unmitigated sound is typically below the limit and no one at the mine is anywhere near within 50 feet of a blast; sound level for anyone near pit during a blast is probably < 80 dBA

[2] L_{EQ} at 50 feet from cyclic operations

3.10.3.4. Sensitive Receptors

The sensitive receptors for noise and air quality in the analysis area are the few people that seasonally use the Redbird property (3.0 miles east of the center of the mine site; 2.2 miles east of the mill); several people that live (year round and seasonally) near the mouth of Thompson Creek; the people that visit or pass through the area for dispersed recreation or wood cutting; and wildlife that live, forage and pass through the area.

3.10.4. Offered Lands - Broken Wing Ranch

3.10.4.1. Climate

The highest average monthly maximum temperatures at the ranch during the period from 1971 to 2000 ranged from 85 °F at the lower elevations to 81 °F at the higher elevations, and occurred during July and August. The average daily maximum temperatures dropped below freezing at the upper elevations in December and January, but rarely dropped below freezing at the lower elevations. The lowest average daily minimum temperature (no distinct variation with elevation) during that period was 7 °F, and occurred in December, January, and February. Monthly average daily minimum temperatures were below freezing for 7 months, from October through April (PRISM 2006a, 2006b).

The average annual precipitation at the ranch ranged from 10 inches at the lower elevations to 14 inches at the higher elevations (PRISM 2006c). From 1961 to 1990 the ranch received an average annual snowfall of 24 inches at the lower elevations and 54 inches at the higher elevations, with most of the snow falling from November to January, and lesser amounts falling from February to April (PRISM 2000).

Winds at the ranch are generally from the west and southwest. The average monthly wind velocities range from less than 2 to 5 mph during April through October, and from 7 to 9 mph during November through March. The average annual wind velocity is 5.1 mph (ICBEMP 1997a). The average highest wind velocity annually for the region is 45 mph, with an average annual occurrence of four peak gusts greater than or equal to 50 mph (NCDC 2002). The ranch locality receives approximately 35 lightning strikes per 62 square miles per year (ICBEMP 1997c).

3.10.4.2. Air Quality

The air quality of the analysis area is affected primarily by mobile sources (vehicle traffic) on SH 75 (CO, NO_2, O_3, SO_2), regional vehicle and equipment emissions, and PM from wildfires, prescribed fires, vehicles traveling on unpaved roads, agricultural tilling, aggregate stockpiles at the nearby Idaho Transportation Department (ITD) sand and gravel pit, sparsely vegetated and dry soils in the locality, operations at the Three Rivers Stone quarry, burning wood for space heating, cattle movement, etc. The background concentrations of criteria pollutants in the analysis area are equivalent to those in the analysis area for the MMPO area and selected land (Section 3.10.3.2). The only pollutant concentration that could approach a NAAQS in the analysis area for the ranch would be the 24 hour $PM_{2.5}$ due to intense wildfire smoke. The most distinct effect to PM_{10} in the analysis area is from agricultural tilling which during high winds may generate elongated light-colored dust clouds up to approximately 1,000 feet in length that disperse within approximately 1 minute (and therefore do not meaningfully affect 24 hour or annual PM concentrations). Perhaps once a month a fugitive dust cloud generated by very high winds at the Three Rivers Stone quarry may reach the southern end of the ranch (0.7 mile north of the quarry) in its final stages of dispersion (Gardner 2012b).

Due to the distance of the mine from the analysis area, criteria pollutants from the mine would not be measurable using standard air quality equipment in the analysis area for the ranch. Therefore, air quality is not discussed further in this FEIS for this analysis area as there would be

no meaningful change in the ambient concentrations of criteria pollutants in the analysis area due to any of the land disposal alternatives.

3.10.4.3. Noise

State Highway 75 and wind are the primary sources of ambient sound in the analysis area, with small amounts of ambient sound produced by ranching activities (cattle, tractors, vehicles, etc). The ambient sound levels are approximately 45 to 50 dBA and 35 dBA L_{DN} within 50 feet and 300 feet, respectively, of the highway (VTN 1980e), comparable to typical outdoor sound levels of 35 to 50 dBA L_{DN} for rural areas (EPA 1974). Commercial air flights do not typically generate sound in the analysis area, but low-flying private aircraft, military jets, and helicopters (e.g., IDFG spawning surveys) may be heard a few times a year in the analysis area. Sound from the Three Rivers Stone quarry or the mine is not audible at the Broken Wing Ranch. The sensitive receptors in the analysis area for noise are residents on the ranch (two residences), residents living within 1,000 feet of the ranch (two residences near the north end and approximately five residences near the southeast end of the ranch), and dispersed recreationalists.

3.10.5. Offered Lands - Garden Creek Property

3.10.5.1. Climate

The highest average monthly maximum temperature at the property during the period from 1971 to 2000 was 78 °F in July. The average daily maximum temperatures were below freezing during December and January. The lowest average monthly minimum temperature was 14 °F in January. Average minimum temperatures were below freezing during November through April (PRISM 2006a, 2006b).

The average annual precipitation during the period from 1971 to 2000 was 37 inches, with approximately 4 inches each month from November to May, and approximately 1.5 inches each month from June to September, with 2.6 inches in October (PRISM 2006c). From 1961 to 1990 the property received an average annual snowfall of 132 inches. Most of the snowfall was during November through April with the highest snowfall during December (30.5 inches) (PRISM 2000).

Winds at the property are generally from the south during June through February, and from the west during March through May. The average monthly wind velocities are 2 to 5 mph throughout the year, with an average annual wind velocity of 2 mph (ICBEMP 1997a). The average highest wind velocity annually for the region is 47 mph, with an average annual occurrence of six peak gusts greater than or equal to 50 mph (NCDC 2002). The Garden Creek locality receives approximately 85 lightning strikes per 62 square miles per year (ICBEMP 1997c).

3.10.5.2. Air Quality

There are no sources of meaningful amounts of criteria pollutants at or near the property. The nearest Title V major air pollutant sources are the Ashgrove cement facility in Inkom and the JR Simplot Don Plant facility 10 miles to the northeast and north, respectively. These facilities are too far from the property to meaningfully affect air quality at the property. Fugitive dust at the property is negligible because of the lack of public vehicle access and the distinctly vegetated

ground surface. Wildfires in the locality may occasionally cause elevated concentrations of $PM_{2.5}$ (e.g., a 24 hour $PM_{2.5}$ of 20 to 70 $\mu g/m^3$) for a few days or weeks at the property. Therefore, criteria pollutants are not discussed further for the analysis area as there would be no meaningful change in the ambient concentrations of these pollutants in the analysis area due to any of the land disposal alternatives.

3.10.5.3. Noise

Ambient sound levels at the property are primarily from wind and wildlife, and are approximately 30 to 40 dBA L_{DN} based on values typical of non-residential rural areas. Vehicle traffic in the vicinity is extremely rare and does not meaningfully contribute to sound at the property. There may occasionally be intermittent air traffic over the property due to the small Pocatello airport approximately 10 miles to the north. Such overflights would have short-term effects up to approximately 60 dBA L_{DN} a few times per day. The sensitive receptors for noise in the analysis area are the few recreationalists who occasionally visit the private property. There are no residences at or within 1,000 feet of the property.

3.10.6. Climate Change

The subject of climate change in recent decades has become a dominant topic in science, politics, and the media. *Climate* refers to the average weather conditions at a given location over time, but also includes more complicated statistics such as the average daytime maximum temperature each month and the frequency of storms or droughts. *Climate change* most generally refers to changes in these statistics over years, decades, and even centuries. However, *climate change* herein refers more specifically to anthropogenic (human-caused) climate change, also known as anthropogenic global warming. Most scientists agree that anthropogenic emissions of GHGs (primarily carbon dioxide) are a substantial cause of the global warming that has occurred since the industrial revolution began (~ 1750). For example, the IPCC (2007) concludes that the probability is greater than 90 percent that most of the increase in global average temperatures since the mid-20th century is due to the increase in anthropogenic concentrations of GHG in the atmosphere. These GHGs result mostly from the burning of fossil fuels for energy, industrial processes, and transportation. JBR (2014j) summarizes the current science of climate change. However, the scope of climate change in this FEIS is limited to the potential effects of the mine on climate change, and the potential effects of climate change on the mine (Section 4.10).

3.10.6.1. Potential Effects of the Mine on Climate Change

The effects of a project on climate change are the emissions of GHGs from the project relative to other emissions of GHGs. Therefore, this section provides quantitative background information for current and projected emissions of GHGs from the MMPO alternatives, Idaho, the Northern Rocky Mountain region, the US, and the world. The GHGs for this analysis are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).

It is important to note that emissions of GHGs may be reported as *direct* emissions, *total* (direct and indirect) emissions, or *net* (total minus sinks) emissions, and that all values of GHG emissions cited below are anthropogenic emissions. Also, only *direct GHGs* (those that directly

cause atmospheric warming) and not *indirect GHGs* (that contribute to the formation or destruction of GHGs) are evaluated in this section.

It is also important to note that *direct* and *indirect* are used differently for emissions of GHGs than for the NEPA. Direct emissions are those from sources owned or controlled by an entity such as fossil fuel burned on site and emissions from entity-owned or entity-leased vehicles. Indirect emissions are those resulting from the generation of electricity, heating and cooling, or steam generated off site but purchased by the entity; and emissions from sources not owned or directly controlled by the entity but related to the entity's activities such as employee commuting and travel, contracted solid waste disposal, etc. Indirect emissions also include those resulting from land use changes, N_20 from the atmospheric deposition of nitrogen from ammonia (NH_3) and NO_x, etc.

The carbon dioxide-equivalent (CO_2e) quantities herein are for global warming potentials of 100 years ($GWPs_{100}$) using the most current values (IPCC 2007), except as noted "IPCC (1996) $GWPs_{100}$." Regardless, either set of GWPs will yield very similar quantities because, e.g., whereas the GWP_{100} for CH_4 increased from 21 to 25, the GWP_{100} for N_2O decreased from 310 to 298. Note that for consistency with the generally available data, all values for CO_2e are in metric tons (T) or million metric tons (MT), as opposed to short tons[16] used elsewhere in the document.

3.10.6.2. World Emissions of GHGs

The trend in world total net emissions of GHGs is a distinct and steady increase, apart from a slight decrease from 2008 to 2009 due to the worldwide economic recession: an average of 0.5 percent per year[17] during 1990 to 2000, and an average of 2.3 percent per year during 2000 to 2009. Overall the emissions increased 5 percent during 1990 to 2000, and 23 percent during 2000 to 2009. Particularly notable is the increase of 61 percent during 2000 to 2009 from Asia, primarily due to China (Table 3.10-5., Table 3.10-6). World total net emissions are projected to be 57,000 MT to 60,000 MT in 2020 (UNEP 2012, Case 1).

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[16] 1 metric ton (T) = 1.102311 short tons

[17] all annual averages herein are calculated as [natural logarithm (last value) - natural logarithm (first value)] / number of intervening years x 100

Table 3.10-5. World total net emissions of GHGs by region.
(MT CO_2e except as noted)

Region	1990	2000	2009	2009 (%)
Asia	10,828	12,921	20,772	42.1
Europe	10,835	8,784	8,243	16.7
North America	7,209	8,287	7,867	15.9
Sub-Saharan Africa	3,491	3,176	4,149	8.4
Middle East	1,747	2,471	3,323	6.7
South America	2,712	2,674	2,849	5.8
International aviation/shipping	663	837	1,011	2.0
Oceania	589	735	801	1.6
Central America/the Caribbean	182	350	314	0.6
World TOTAL	**38,258**[1]	**40,234**[1]	**49,329**[1]	**100.0**[1]

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
JRC/PBL (2012) using IPCC (1996) $GWPs_{100}$

Table 3.10-6. Countries with the largest total net emissions of GHGs in 2009.
(MT CO_2e except as noted)

Country	1990	2000	2009	2009 Per Capita (T CO_2e)
TOP 12 COUNTRIES BY LARGEST 2009 EMISSIONS				
China	3,870	5,073	10,608	8.0
US[1]	6,115	6,983	6,515	21.2
Indonesia	1,161	1,445	2,620	11.4
India	1,376	1,873	2,584	2.2
Russian Federation	3,582	2,647	2,481	17.5
Brazil	1,605	1,463	1,433	7.4
Japan	1,302	1,412	1,318	10.4
DR Congo	1,377	1,037	1,077	16.3
Germany	1,254	1,048	982	12.0
Canada	604	736	709	21.0
Australia	482	605	667	30.2
México	489	569	644	6.0

Country	1990	2000	2009	2009 Per Capita (T CO_2e)
TOP 12 COUNTRIES BY LARGEST PER CAPITA 2009 EMISSIONS				
Falkland Islands	1.2	1.2	1.2	468.2
Guyana	16.7	14.46	171.3	218.3
Montserrat	0.1	0.4	0.6	113.8
Central African Rep.	251.6	191.0	459.6	100.4
Iceland	21.8	21.3	22.7	75.8
Qatar	20.8	44.4	93.3	66.7
Guinea	65.2	57.9	566.9	52.4
Brunei Darussalam	18.4	17.1	19.9	49.8
United Arab Emirates	72.1	115.0	193.7	42.1
Trinidad and Tobago	15.1	23.2	54.1	41.6
Netherlands Antilles	3.0	6.0	8.2	39.3
Bahrain	17.1	18.3	29.8	37.3
World TOTAL	**38,258**	**40,234**	**49,329**	**7.3**

[1] The difference in the value for the US in this table compared to the (net) value in Table 3.10-6. is an example of the differences that result from different GHG inventory methods; only ~ 2 % of the difference is from using different $GWPs_{100}$): 6,633.2 MT using the IPCC (1996) $GWPs_{100}$ versus 6,767.5 MT using the IPCC (2007) $GWPs_{100}$ (EPA 2011).
JRC/PBL (2012) using IPCC (1996) $GWPs_{100}$

3.10.6.3. US Emissions of GHGs

US total emissions of GHGs (excluding sinks) in 2009 were 6,767.5 MT CO_2e, of which 81.3 percent (5,505.2 MT) was CO_2 produced mostly (94.6 %) from fossil fuel combustion. Notable is the dramatic increase (44,000 %) from 0.3 MT CO_2e in 1990 to 132.3 MT CO_2e in 2009 of HFCs due to substitution of O_3-depleting substances (Table 3.10-7., Table 3.10-8.) (EPA 2011). US total emissions of GHGs (excluding sinks) increased an average of 1.4 percent per year during 1990 to 2000, and *decreased* an average of 0.8 percent per year during 2000 to 2009.

3.10.6.4. Regional Emissions of GHGs

The topography and climate of southeastern Idaho are most closely related to the neighboring Northern Rocky Mountains states of Montana, Wyoming and Utah, which have somewhat similar climatic, ecological and population attributes. The total emissions of GHGs, population, and per capita emissions in Idaho are similar to the averages for the region (Table 3.10-9). Note that the emissions include sinks (e.g., large negative values for Montana due to extensive forests), and are consumption-based (i.e., excluding emissions associated with exported electricity). The increase in total emissions of GHGs from Idaho, Montana, Utah, and Wyoming during 1990 to 2009 was 39.4 percent, 88.2 percent, 68.9 percent, and 72.4 percent, respectively. During this period the US total emissions of GHGs increased 7.3 percent.

3.10.6.5. Idaho Emissions of GHGs

The largest sources of total emissions of GHGs by consumption sector in Idaho are currently transportation and agriculture. The per capita total emissions of GHGs in 2009 were 24.5 T, compared to per capita emissions of 13.1 T, 22.0 T, 42.3 T and 22.0 T for Montana, Utah, Wyoming, and the US, respectively (Table 3.10-9., Table 3.10-10).

3.10.6.6. Mine Emissions of GHGs

The NEPA analysis of the potential effects of a project on climate change is based on annual, *direct* emissions of GHGs with a threshold value of 25,000 T per year (CEQ 2010). The focus on direct emissions is appropriate because indirect emissions (e.g., those from contracted solid waste disposal; vendor supply chains; off-site electricity production,[18] transportation and distribution; etc.) are outside the control of a project proponent. In addition, there is insufficient information to reasonably calculate the quantities of many indirect emissions.

Table 3.10-7. US emissions of GHGs by source (MT CO_2e).

Gas/source	1990 (MT CO_2e)	2000 (MT CO_2e)	2009 (MT CO_2e)
CO_2	**5,099.7**	**5,975.0**	**5,505.2**
Fossil fuel combustion	4,738.4	5,594.8	5,209.0
Non-energy use of fuels	118.6	144.9	123.4
Iron and steel production	99.5	85.9	41.9
Natural gas systems	37.6	29.9	32.2
Cement production	33.3	40.4	29.0
Land use, land-use change, and forestry (sink)	-861.5	-576.6	-1,015.1
CH_4	**803.4**	**785.6**	**817.0**
Natural gas systems	226.0	249.2	263.4
Enteric fermentation	157.3	162.5	166.4
Landfills	175.5	132.9	139.8
Coal mining	100.1	71.9	84.6
N_2O	**303.0**	**327.8**	**284.2**

[18] Regardless, most of the electricity (~ 90 %) used by the mine is hydroelectricity purchased from the Bonneville Power Administration (Leuzinger 2013), and no emission factors are currently used in emission inventories for hydroelectricity (IPCC 2013). More specifically, there are no direct emissions of GHGs from hydroelectricity, and the only indirect emissions of GHGs are from the construction of the facilities and biomass decomposition from reservoir flooding. Research is on-going to try to determine acceptable emission factors for these indirect emissions, which currently range from 0.5 kilogram (kg) CO_2e/megawatt-hour (MWh) to 152 kg CO_2e/MWh, still very small compared to the emissions (direct and indirect) of coal-fired power plants (~ 1,000 kg CO_2e/MWh) (Steinhurst et al. 2012). The remainder of the electricity used by the mine is nuclear energy (Leuzinger 2013), which also has no direct emissions of GHGs, and similarly unknown but relatively small indirect emissions of GHGs, e.g., 1.4 kg CO_2e/MWh to 288 kg CO_2e/MWh, with an average value of 66 kg CO_2e/MWh (Sovacool 2008).

Gas/source	1990 (MT CO_2e)	2000 (MT CO_2e)	2009 (MT CO_2e)
Agricultural soil management	190.1	198.8	196.7
Mobile combustion	42.2	51.1	23.0
Manure management	13.9	16.4	17.2
Nitric acid production	17.0	18.7	14.0
Stationary combustion	12.3	14.0	12.3
HFCs	**46.6**	**116.9**	**139.5**
Substitution of O_3-depleting substances	0.3	80.4	132.3
HCFC-22 production	46.1	36.2	6.8
PFCs	**24.4**	**16.2**	**7.5**
Semiconductor manufacture	2.9	6.3	5.6
Aluminum production	21.6	9.9	1.9
SF_6	**32.8**	**19.2**	**14.2**
Electrical trans. and distribution	27.1	15.3	12.2
Magnesium prod. and processing	5.2	2.9	1.0
TOTAL	**6,309.9**	**7,240.7**	**6,767.5**
NET (Sources and Sinks)	**5,448.4**	**6,664.1**	**5,752.4**

Only the largest sources in 2009 are shown for each GHG (EPA 2011, from Annex 6 using IPCC 2007 $GWPs_{100}$), i.e., the subtotals under the bold values do not total.

Table 3.10-8. US net emissions of GHGs in 2009.

Gas	MT CO_2e	(%)
CO_2	5,505.2	81.35
CH_4	817.0	12.07
N_2O	284.2	4.20
HFCs	139.5	2.06
SF_6	14.2	0.21
PFCs	7.5	0.11
TOTAL	**6767.5**[1]	**100.00**

[1] The total is correct but the sum of the values does not total exactly due to independent rounding.
EPA (2011)

Table 3.10-9. Regional net emissions of GHGs (MT CO_2e except as noted).

Total Emissions of GHGs					
State	**1990**	**2000**	**2009**	**% (of region)**	**2020**
Idaho	27.2	35.6	37.9	28.1	42.9
Montana	6.8	10.7	12.8	9.5	16.3
Utah	36.3	52.9	61.3	45.4	83.1
Wyoming	8.0	15.4	23.0	17.0	32.9
Region	78.3	114.6	135.0	100.0	175.2

2009 Population				
Idaho	**Montana**	**Utah**	**Wyoming**	**Region**
1,545,801	974,989	2,784,572	544,270	5,849,632

2009 Per Capita Emissions (T CO_2e)				
24.5	13.1	22.0	42.3	30.0

Baile et al. (2007a, 2007b), Roe et al. (2007), Strait et al. (2008), US Census Bureau (2012b), IPCC (1996) $GWPs_{100}$

Table 3.10-10. Net emissions of GHGs for Idaho (MT CO_2e except as noted).

Sector	1990	2000	2009[1]	2009 (%)	2020
Transportation	7.2	10.0	10.8	27.7	12.2
Agriculture	6.8	9.0	9.7	24.9	10.0
Residential/commercial	5.1	6.8	6.6	16.9	7.7
Electricity	3.9	4.9	5.3	13.4	7.3
Forestry/land use	3.6	3.6	3.6	9.2	3.6
Waste management	1.0	1.2	1.5	3.7	1.8
Industrial processes	0.4	0.8	1.2	3.2	1.9
Fossil fuel industry	0.3	0.4	0.4	1.2	0.6
Source emissions	**28.4[2]**	**36.8[2]**	**39.12[2]**	**100.0[2]**	**44.98[2]**
Agricultural soils	-1.2	-1.2	-1.2		-1.2
TOTAL	**27.2[2]**	**35.6[2]**	**37.92[2]**		**43.78[2]**

[1] The 2009 data is interpolated between the 2005 and 2010 data.
[2] The totals are correct but the sum of the values does not total exactly in all cases due to independent rounding.
Strait et al. (2008), IPCC (1996) $GWPs_{100}$

However, to be conservative, the emissions of mine-related GHGs presented below include the indirect emissions from commuter traffic over which TCMC has slight control (e.g., shuttle buses); the indirect emissions from the removal of forest (via decreased carbon sequestration) at

the mine would be negligible.[19] Essentially all of the emissions of GHGs attributed to the mine are indirect (NEPA) emissions from mining activity (mostly the onsite vehicle fleet) on non-Federal lands. The only direct (NEPA) emissions would be a very small fraction (< 1 %) of the emissions from the vehicle fleet attributable to hauling and placing waste rock on Federal lands.

The emissions of GHGs were determined for four mining scenarios: 1) molybdenum mining (~ 400 employees) during which the emissions of past, present and future molybdenum mining were considered to be the same, 2) core reclamation after molybdenum production has ceased (~ 230 employees) during 3 years following the end of molybdenum mining, 3) late-stage reclamation (~ 20 employees) for 5 years following core reclamation, and 4) subsequent long-term reclamation (~ 5 employees) for the foreseeable future. Note that the values for the mine are in T and not MT (Table 3.10-11., Table 3.10-12., Table 3.10-13., Table 3.10-14).

Table 3.10-11. Annual emissions of GHGs for mine, molybdenum mining (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	4,302.9	0.0	0.2	0.0	4,303.1
Onsite TCMC vehicle fleet	33,158.6	280.9	422.3	152.1	34,013.9
Ore shipments to PA refinery	3,455.7	71.3	5.8	186.4	3,719.2
TCMC commuters	6,802.1	17.7	1.6	40.4	6,861.8
Shipments to/from mine	544.2	1.4	0.1	3.2	548.9
TOTAL[1]	**48,263.4**	**371.3**	**430.1**	**382.1**	**49,446.9**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
TCMC (2012c), IPCC (2007) $GWPs_{100}$

[19] carbon sequestration for average US forest = 0.33 T carbon/acre/year (EPA 2011b); 364.1 acres of forest removed; 364.1 acres x 0.33 T carbon/acre/year x 3.664 T CO_2e/1 T carbon = 440 T CO_2e/year

Table 3.10-12. Annual net emissions of GHGs for mine, core reclamation (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	2,474.4	0.0	0.1	0.0	2,474.3
Onsite TCMC vehicle fleet	19,066.2	161.5	242.8	87.4	19,558.0
Ore shipments to PA refinery	1,987.0	41.0	3.3	107.2	2,138.5
TCMC commuters	0.0	0.0	0.0	0.0	0.0
Shipments to/from mine	312.9	0.8	0.1	1.9	315.6
TOTAL[1]	**23,840.2**	**203.4**	**246.4**	**196.5**	**24,486.5**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
TCMC (2012c), IPCC (2007) $GWPs_{100}$

Table 3.10-13. Annual net emissions of GHGs for mine, late-stage reclamation (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	0.0	0.0	0.0	0.0	0.0
Onsite TCMC vehicle fleet	1,657.9	14.0	21.1	7.6	1,700.7
Ore shipments to PA refinery	172.8	3.6	0.3	9.3	186.0
TCMC commuters	0.0	0.0	0.0	0.0	0.0
Shipments to/from mine	27.2	0.1	0.0	0.2	27.4
TOTAL[1]	**1,857.9**	**17.7**	**21.4**	**17.1**	**1,914.1**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.
TCMC (2012c), IPCC (2007) $GWPs_{100}$

Table 3.10-14. Annual net emissions of GHGs for mine, long-term reclamation (T CO_2e).

Sector	CO_2	N_2O	CH_4	HFCs	TOTAL
Onsite mine boilers	0.0	0.0	0.0	0.0	0.0
Onsite TCMC vehicle fleet	414.5	3.5	5.3	1.9	425.2
Ore shipments to PA refinery	43.2	0.9	0.1	2.3	46.5
TCMC commuters	0.0	0.0	0.0	0.0	0.0
Shipments to/from mine	6.8	0.0	0.0	0.0	6.9
TOTAL[1]	**464.5**	**4.4**	**5.4**	**4.3**	**478.5**

[1] The totals are correct but the sum of the values may not total exactly due to independent rounding.

TCMC (2012c), IPCC (2007) $GWPs_{100}$

3.10.6.7. Offered Lands

There are no meaningful emissions of GHGs related to the offered lands. The largest direct emissions are probably from vehicles driving to and from the lands, or perhaps livestock on the Broken Wing Ranch. However, although livestock produce substantial emissions of GHGs on a global basis, the 300 AUMs at the ranch would produce de minimis (< 25,000 T/year direct) GHG emissions. For example, the entire 51,000 AUMs authorized by the BLM Challis Field Office (BLM 1999) produce annually some 700 to 17,600 T of direct emissions of GHGs (Gardner 2011a). Therefore, emissions of GHGs related to the offered lands are not further analyzed.

3.11. Visual (Aesthetic) Resources

The analysis area for visual (aesthetic) resources for the MMPO alternatives are the landscape views centered on the mine that are visible from the KOPs (Table 3.11-1., Figure 3.11-1). The analysis area for the land disposal alternatives is the selected and offered lands.

Most of the selected land and the portion of the mine on BLM land are in an area designated under the VRM program as Class III. The selected land and the portion of the mine on BLM land nearest Thompson Creek are in an area designated as Class II (Figure 3.11-1). The objective of Class III, Partial Retention, is to design proposed alterations to partially retain the existing character of the landscape. Contrasts to the basic elements (form, line, color and texture) caused by a management activity may be evident and begin to attract attention in the characteristic landscape. The objective of Class II, Retention, is to design proposed alterations to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer (BLM 1999).

Note that these objectives are not legal standards. Rather, the BLM will require visual mitigation, if technologically and economically feasible, when visual mitigation would cause a project to meet the designated VRM class from a KOP that would otherwise not be met. Portions of the mine are also in Forest Service management areas (MAs) 6 and 9. The management prescriptions for these areas provide no specific guidance for management of visual resources. The general VQO for this portion of the NFS land is Modification "…management activities may visually dominate the original characteristic landscape" (Figure 3.11-1.) (USFS 1974).

No KOPs were identified for the offered lands because the proposed BLM administration of these lands would not materially change the landscapes of the Broken Wing Ranch or Garden Creek property, or, in the case of the ranch, the potential material changes (e.g., an Idaho Department of Parks and Recreation campground) would be too speculative to analyze in this FEIS. Regardless, the visual characteristics of the offered lands are briefly described in this section. All of the KOP photos of the MMPO area and selected land in the following sections are from September 2009.

Table 3.11-1. Key observation points.

KOP	Description
1	Custer Lookout
2	No Name Drainage
3	South Butte
4	SH 75
5	Railroad Ridge
6	Pat Hughes WRSF

3.11.1. MMPO Area and Selected Land

3.11.1.1. KOP 1 – Custer Lookout

The Custer Fire Lookout KOP is on Custer Peak (9,753 feet elevation) in the SCNF 3.25 miles northwest of the MMPO area and selected land. The lookout is no longer utilized by the Forest Service and receives no regular maintenance. However, the lookout is a distinctive landmark and point of interest along a popular trail with expansive views in all directions. The KOP is on the trail below the lookout, with the mine visible to the southeast in the background of the panoramic landscape (Photo 3.11-1). The western edge of the selected land is also visible in the center of the photo.



Photo 3.11-1. KOP 1 – View southeast from trail below Custer Lookout.

The KOP is at a higher elevation than the surrounding topography allowing a clear view of the landscape elements of the MMPO area. The viewshed is characterized by distinctly mountainous terrain. The dissected landscape comprises massive, angular mountains and ridges that contrast distinctly against adjacent deep, shadowed valleys and ravines. Irregular, horizontal ridgelines become less distinct as they overlap one another and recede into the background. Mountainsides are covered with a medium-textured, gray-green understory of shrubby sage and vertical grasses, punctuated with varying degrees of spiky dark green conifers. The uneven pattern of vegetative cover accentuates and reveals the underlying landforms, especially drainages.

The mine appears as a thin tan or white line with dust emanating from it in the center of the middle ground. The mine provides a noticeable color and texture contrast between a patch of smooth-textured, light tan against the medium-textured, darker gray green matrix described above. The mine also has created a flat surface that somewhat contrasts with the more rugged form of surrounding mountains and ridges. However, the dominant line at the mine site is the natural angle of the top of Buckskin-Basin Creek divide (middle ground, photo left). The mine is the only human-made feature visible in the landscape, and somewhat draws the attention of the casual observer.

3.11.1.2. KOP 2 – No Name Drainage

The No Name Drainage KOP is on Thompson Creek Road, 1 mile due south of the pit. The road is in the deep valley along the Thompson Creek drainage. Thompson Creek (centerline) is the division between BLM and NFS lands. The view from KOP 2 is north toward the open pit (not visible behind the farthest ridge) and of an upslope, moderately closed landscape (Photo 3.11-2). The landscape comprises steep mountainsides of pyramidal and trapezoidal form, with the slopes forming diagonal lines in the middle ground and the slopes forming rough-ridged diagonal lines and a short horizontal line in the center of the view in the background. The mountainsides are covered with a medium-textured, gray-green understory of shrubby sage and vertical grasses, punctuated with varying degrees of spiky dark green conifers. Rock outcrops near the horizon in the background are rough and angular, gray-brown in color with deep shadows. No human-made features are visible from KOP 2.



Photo 3.11-2. KOP 2 – View north.

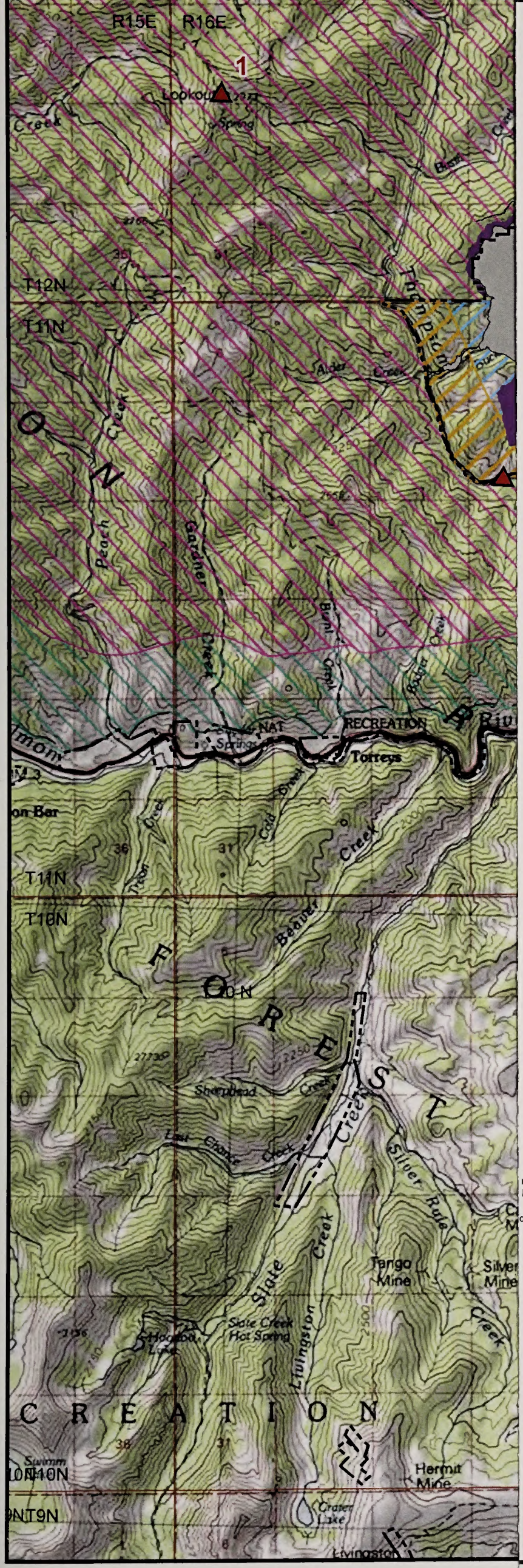
3.11.1.3. KOP 3 – South Butte

Due to topography, the mine is not visible from S. Creek Road. Therefore, the South Butte KOP is on BLM land 2.5 miles southeast of the TSF along a two-track access road upslope of S. Creek Road. The KOP provides a panoramic view of the landscape, with a focus on the TSF embankment in the middle ground (Photo 3.11-3). Rugged mountains in the middle ground and distance have pyramidal and trapezoidal form with several diagonal lines as the landforms overlap. The open vegetated meadow in the foreground and mountains contrasting with the sky at the horizon in the background create generally undulating horizontal lines. Vegetation in the foreground is coarse-textured, gray-green to tan, short, shrubby to grassy transitioning to medium-textured in the middle ground. Vegetation in the middle ground and distance is patchy shrubs and grasses, and very dark green conifer forest. The TSF embankment is a light gray, inverted pyramid with a distinct horizontal line on top that draws the viewer's attention.



Photo 3.11-3. KOP 3 – View west.

The TSF embankment has a northeast to southwest axis. The light tan to pale gray color of the embankment contrasts distinctly with the brown to dark green, almost black, vegetated mountain slopes. The top of the embankment creates a smooth, flat, horizontal line in the middle of the diagonal lines of multiple soft, rolling mountain slopes. The embankment is obvious to the casual observer, but does not dominate the landscape. Aside from the embankment, no human-made features are visible from KOP 3.



Legend

- Existing mining disturbance
- MMPO areas/Alternatives M2 and M3
- Forest Service Boundary

KOP Locations

- 1 - Custer Lookout
- 2 - No Name Drainage
- 3 - South Butte
- 4 - Highway 75
- 5 - Railroad Ridge
- 6 - Pat Hughes Waste Rock Storage Facility

Visual Resource Management Classes

- II
- III

Visual Quality Objectives

- M
- R

N

1:100,000

1 0 1
Miles

1 0 3
Kilometers

mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Management Area (VRM) from Bureau of Land Management, Idaho State Office. Visual Quality Objections (VQO)
from USFS Corporate Data
opographic background from USGS 100,00-scale metric topographic map and NAIP 2009 imagery.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 3.11-1
Visual resource information, MMPO area and selected land
Thompson Creek Mine EIS

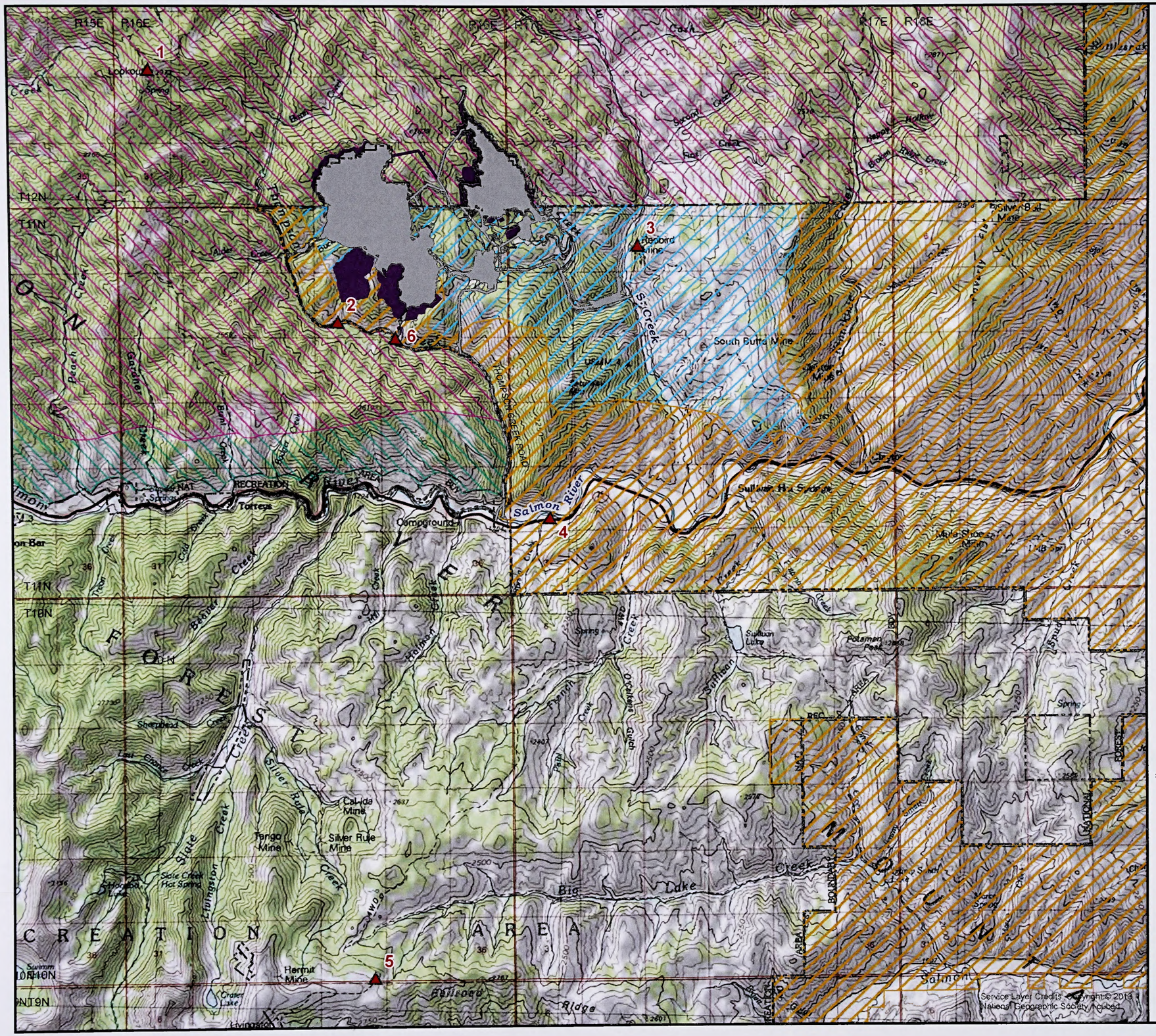
3.11.1.3. KOP 3 – South Butte

Due to topography, the mine is not visible from S. Creek Road. Therefore, the South Butte KOP is on BLM land 2.5 miles southeast of the TSF along a two-track access road upslope of S. Creek Road. The KOP provides a panoramic view of the landscape, with a focus on the TSF embankment in the middle ground (Photo 3.11-3). Rugged mountains in the middle ground and distance have pyramidal and trapezoidal form with several diagonal lines as the landforms overlap. The open vegetated meadow in the foreground and mountains contrasting with the sky at the horizon in the background create generally undulating horizontal lines. Vegetation in the foreground is coarse-textured, gray-green to tan, short, shrubby to grassy transitioning to medium-textured in the middle ground. Vegetation in the middle ground and distance is patchy shrubs and grasses, and very dark green conifer forest. The TSF embankment is a light gray, inverted pyramid with a distinct horizontal line on top that draws the viewer's attention.



Photo 3.11-3. KOP 3 – View west.

The TSF embankment has a northeast to southwest axis. The light tan to pale gray color of the embankment contrasts distinctly with the brown to dark green, almost black, vegetated mountain slopes. The top of the embankment creates a smooth, flat, horizontal line in the middle of the diagonal lines of multiple soft, rolling mountain slopes. The embankment is obvious to the casual observer, but does not dominate the landscape. Aside from the embankment, no human-made features are visible from KOP 3.



Legend

- Existing mining disturbance
- MMPO areas/Alternatives M2 and M3
- Forest Service Boundary

KOP Locations

- 1 - Custer Lookout
- 2 - No Name Drainage
- 3 - South Butte
- 4 - Highway 75
- 5 - Railroad Ridge
- 6 - Pat Hughes Waste Rock Storage Facility

Visual Resource Management Classes

- II
- III

Visual Quality Objectives

- M
- R

N

1:100,000

1 0 1 Miles

1 0 3 Kilometers

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Visual Resource Management Area (VRM) from Bureau of Land Management, Idaho State Office. Visual Quality Objections (VQO) from USFS Corporate Data.
Topographic background from USGS 100,00-scale metric topographic map and NAIP 2009 imagery.
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

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Figure 3.11-1
Visual resource information, MMPO area and selected land Thompson Creek Mine EIS

3.11.1.4. KOP 4 – SH 75

The KOP is 5.3 miles south-southwest of the TSF embankment adjacent to SH 75 in front of the Old Sawmill Station (store, deli, RV and trailer park, gas station). The area is 4.1 miles west of Clayton near the mouth of S. Creek. In addition to the Old Sawmill Station, the area has a variety of residences. The highway in front of KOP 4 is at the base of the valley containing the Salmon River, and the highway is the main travel route southwest of Challis to Stanley, Sun Valley, Ketchum, Shoshone, etc.

The view from KOP 4 is northwest toward the MMPO area and selected land (neither visible) of a closed landscape of rolling hills with distinct diagonal lines along the slopes (Photo 3.11-4). An undulating horizontal line is formed where the hills meet the sky. The valley bottom along the highway is flat. The foreground appears blotchy, containing fine to medium textured bright green and tan grasses.

The middle ground has medium textured vegetation with gray-green and tan shrubs and grasses. Vegetation toward the background is patchy with dark green stands of conifer. The highway, fence and power line provide distinct horizontal to slightly diagonal lines in the foreground that are slightly broken by individual and small groups of trees. Low buildings lining the road echo the horizontal elements and offer slight diagonal elements in gray and white.



Photo 3.11-4. KOP 4 – View north.
View from Sinclair gas station at Old Sawmill Station adjacent to SH 75 at milepost 218.6.

3.11.1.5. KOP 5 – Railroad Ridge

The Railroad Ridge KOP is on NFS land 11 miles south of the mine in the Sawtooth National Recreation Area. The open, panoramic landscape of the KOP provides distant views of numerous mountains and ridges, with those in the middle ground forming subtle diagonal lines, and those in the background forming an irregular horizontal line where they contrast with the sky (Photo 3.11-5). Medium-textured, short, vertical tan grasses in the foreground transition to broken views of patchy, fine-textured stands of conifer in the middle ground. The expanses of grasses in the foreground are dotted with scattered, large white rocks. In the background, fine- to medium-textured vegetation is patchy gray-green to dark green. The only human-made features visible from KOP 5 are a portion of the pit, the Upper Buckskin WRSF, and a portion of the top of the TSF.



Photo 3.11-5. KOP 5 – View north.

The pit and Upper Buckskin WRSF appear as mottled light tan and brown (middle ground, photo center) and the embankment appears more smooth light brown (middle ground to background, left of photo center). These colors contrast with the surrounding dark green to blue colors of the conifer vegetation, making the mine clearly visible, and a portion of the embankment somewhat visible. The upper edges of the pit and Upper Buckskin WRSF also appear as a light gray,

horizontal band. The TSF embankment appears as a thin, light gray, horizontal band. The patchy vegetation and landforms in the landscape somewhat reduce the overall contrast, particularly for the embankment. Because the landscape is a complex combination of multiple lines, colors, patterns and textures, and because of the distance between KOP 5 and the mine, the mine features do not dominate the landscape.

3.11.1.6. KOP 6 – Pat Hughes Waste Rock Storage Facility

The Pat Hughes WRSF KOP is on BLM land at the entrance to a gated area adjacent to the north side of Thompson Creek Road, 0.30 mile south-southeast of the Pat Hughes WRSF. The view from KOP 6 is focused on the WRSF, at the convergence point of diagonal slope lines in an enclosed landscape. The light yellow white to tan and gray colors of the waste rock, contrast moderately with the surrounding darker land and vegetation. The smooth, flat, horizontal line at the top of the facility adds a horizontal element that repeats the horizontal line where the flat topography of the foreground meets the gentle slopes of the middle ground. The texture of the facility is smooth to slightly stippled and contrasts distinctly with the surrounding vegetation. The combination of these visual characteristics causes the WRSF to dominate the view from KOP 6.



Photo 3.11-6. KOP 6 – View north-northeast.

3.11.2. Mine Lighting and Dark Night Skies

Only 38 percent of the US is below the threshold for light pollution, i.e., artificial sky brightness is less than 11 percent of natural night sky brightness above 45 degrees of elevation. However, most of Custer County is below this threshold except for Challis, Mackay and Stanley (up to 100 % artificial night sky brightness), and the mine (up to 300 % artificial night sky brightness) (Figure 3.11-2). Some areas in the US have more than 2,700 percent artificial night sky brightness (Cinzano et al. 2001). The mine typically operates 24 hours per day. Lighting is required at night for safe operations (30 CFR 56.17001). This lighting produces a distant glow above the mine visible at night from areas from which the mine would not otherwise be visible. In addition, the centerline of the TSF embankment is lit with 26,400 watt sodium vapor lights (Doughty 2012). These sodium vapor lights contribute substantially to the nighttime glow of the mine. The lights on the TSF embankment are also individually visible at night as a line of yellowish dots from the KOPs from which the embankment is visible. The attention of the casual observer is distinctly drawn to the glow/lights from KOP 1, KOP 3, and KOP 6. The attention of the casual observer is slightly drawn to the glow/lights from KOP 5.

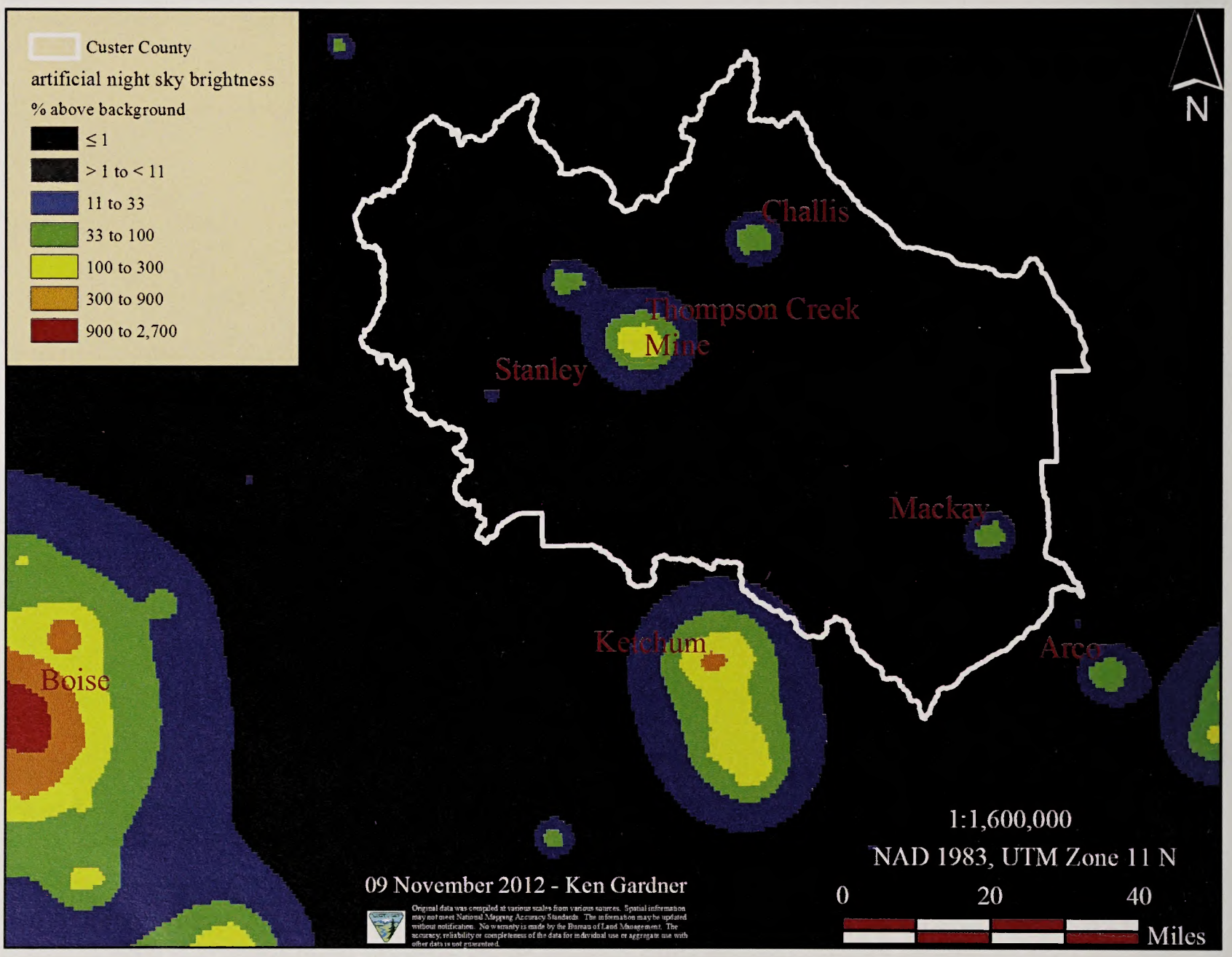


Figure 3.11-2. Percent artificial night sky brightness.

gray areas are unpolluted, but show how far light propagates from sources; bright area northwest of the mine is the former Grouse Creek mine (brightness data is from 1996-1997) (Cinzano et al. 2001)

3.11.3. Offered Lands - Broken Wing Ranch

The ranch is in an enclosed landscape in a flat valley bottom along the Salmon River (Photo 3.11-7). The valley bottom is bounded on either side by steep, undulating slopes capped with weathering rock (talus). The valley bottom is broken by the meandering course of the Salmon River, with rugged mountains forming the background. The ranch provides a pastoral setting, which includes grazing cattle, cultivated fields, irrigation systems, a few farm structures, and a combination of wood rail and barbed wire fencing. Some of the structures appear more than 50 years old, indicating farming has occurred on the ranch for many decades. The three residential complexes provide a variety of point light sources visible at night.



Photo 3.11-7. Broken Wing Ranch, view to south from adjacent to SH 75 (June 2009).

3.11.4. Offered Lands - Garden Creek Property

The property is in an area of gently sloping mountains. The property is heavily forested with mature conifers and aspen, and contains small, enclosed meadows of grasses and low shrubs. The meadows offer views of the surrounding mountain peaks with little indication of human development (the only evidence of human development on the property are fences and a few cut tree stumps).

3.12. Land Use and Recreation

The analysis area for land use and recreation for the MMPO is the MMPO area. The analysis area for the land disposal alternatives is the selected land; the relevant areas of the land disposal provisions (Section 2.2.7.), the Salmon River corridor enclosing the Broken Wing Ranch; the Garden Creek property; and the BLM and NFS lands adjacent to and in the vicinity (e.g., within a few miles) of the property. The analysis areas also include the recreational access routes to the MMPO area, selected land, Broken Wing Ranch, and Garden Creek property. This section also

identifies the special management areas (SMAs) in the region of each analysis area, and briefly discusses the SMAs that include any portion of an analysis area.

In general, there are many types of SMAs on NFS and BLM lands including wilderness areas, wilderness study areas (WSAs), lands with wilderness characteristics, national parks, national monuments, national wildlife refuges, national conservation areas, NRAs, wild and scenic river corridors, areas of critical environmental concern (ACECs), extensive recreation management areas (ERMAs), special recreation management areas (SRMAs), IRAs, herd management areas (HMAs), etc.

3.12.1. MMPO Area and Selected Land

3.12.1.1. Land Use

The BLM Challis Field Office area contains 792,567 acres of BLM land administered under the Challis RMP. The majority (90.2 %) of the land is in Custer County, and the remainder is in Lemhi County (BLM 1998). The NFS land associated with the MMPO area is administered by the SCNF Challis–Yankee Fork Ranger District under the Challis National Forest LRMP[20] (USFS 1987). The SCNF contains 4,235,940 acres of NFS land, of which 1,772,469 acres are in the Salmon National Forest and 2,463,471 acres are in the Challis National Forest. Most of the Challis National Forest (1,873,004 acres, 76 %) is in Custer County (USFS 2012c). Under Alternative M2 there would be additional disturbance on 446.7 acres on private, BLM, and NFS land (Figure 1.2-1., Table 3.12-1). The selected land is 5,142 acres of BLM land, which surrounds and includes all of the BLM land in the MMPO area. The selected land is surrounded by NFS, BLM, and private land (Figure 1.2-1).

Table 3.12-1. MMPO area (Alternative M2) jurisdiction.

Land Status	Private (TCMC) (acres)	BLM Land (acres)	NFS Land (acres)
Permitted[1]	18.1	6.5	2.3
Unpermitted	76.9	191.8	151.9
TOTAL	**95.0**	**198.3**	**154.2**

[1] permitted for mine development in 1980 (USFS 1980)

The analysis area, apart from the mine, consists of undeveloped, rocky or forested land. The area has historically been used for mining; limited commercial timber harvest; very limited livestock grazing (Section 3.5.1.); very limited wood cutting (firewood and post/poles); and dispersed recreation. Mining disturbs 451 acres of the selected land including a widely distributed network of sedimentation ponds, access roads, and utility corridors.

[20] The Salmon and Challis national forests were administratively combined in 1995, but are managed under separate land use plans.

The MMPO area and selected land are within a block of approximately 17,000 acres of patented and unpatented mining claims owned or controlled by TCMC. The core of the MMPO area consists of 2,686 acres of patented mining claims (TCMC private property), all of which have mine disturbance. The other mining claims are unpatented, i.e., the land remains under Federal title but a private entity (TCMC) has asserted a right of possession of locatable (e.g., molybdenum) minerals under Federal mining laws. These laws allowed TCMC to receive title to the mining claims occupied or that would imminently be occupied by the mine (most but not all of the approved Phase 7 operations). Congress has subsequently prohibited the BLM from accepting patent applications under Federal mining laws. Consequently, mining companies now sometimes propose land exchanges with Federal land management agencies to acquire fee simple ownership of mine sites instead of acquiring such ownership under Federal mining laws. Mining companies always desire fee simple ownership of their mine sites to better control access, minimize political risk, obtain bank loans, reduce the time and costs of dealing with multiple land management agencies, etc.

The Federal easements, leases, or permits associated with the selected land are the current MPO (IDI-33145) and a variety of ROW grants. All of the current mining, including related power lines, roads, fiber optic lines, pipelines, etc. are authorized by the MPO under Federal mining laws. However, TCMC has also obtained ROWs under the FLPMA for some of this infrastructure, particularly the infrastructure that is more peripheral to the core mine operations such as the power lines and/or pipelines along Thompson Creek Road, Cherry Creek Road, Pat Hughes Creek Road, and Buckskin Creek Road (IDI-20155). In addition, TCMC has exclusive (non-public) ROWs for the Bruno Creek, Cherry Creek, Pat Hughes, and Buckskin roads (IDI-27080).

Other ROWs in the analysis area include a road ROW reserved to the BLM for the Bruno Creek Road (IDI-017135), Thompson Creek Road (IDI-017139), and Buckskin Road (IDI-017138); a telephone cable ROW and fiber optic cable ROW granted to Custer Telephone Cooperative along S. Creek Road and Bruno Creek Road (IDI-16925); a fiber optic cable ROW granted to Custer Telephone Cooperative along S. Creek Road (IDI-35891); a road ROW for S. Creek Road granted to the Forest Service (IDI-012511); a road ROW from S. Creek Road to a water facility (headgate and fish screen) ROW on S. Creek granted to the IDFG (IDI-35531) for an irrigation ditch owned by TCMC; and a road ROW for S. Creek Road granted to Custer County (IDI-20147).

The ROWs, or their portions on the selected land, would be relinquished by TCMC at title transfer if TCMC were to acquire the selected land. In such case, the other holders of ROWs would be given the opportunity to amend their ROWs to perpetual terms or convert their ROWs to easements prior to title transfer, such that the ROWs and/or easements would be recognized as valid existing rights in title that TCMC might acquire. The power lines along S. Creek Road and Bruno Creek Road are authorized only by the current MPO. However, the BLM would amend an existing ROW to Salmon River Electric Cooperative to include these power lines if the power lines would no longer be authorized by a MPO, but would still be necessary for the locality. All of the mining claims on the selected land (~ 500) would be relinquished at the time of title transfer.

The BLM land in the analysis area is in the Challis ERMA (~ 750,000 acres of BLM land not in a more specific SRMA). The primary recreation in this region of the ERMA is hiking, fishing, hunting, camping, antler shed collection, nature photography, horseback riding, and recreational driving (depending on access). People also cut wood for firewood and posts/poles in the ERMA. These activities are widely dispersed and are difficult to manage. There are three off-highway vehicle (OHV) plans that designate portions of the ERMA as open, limited or closed to OHV use (BLM 2009b). The ERMA is managed according the general guidance in the Challis RMP (1999).

The BLM, NFS, and State lands in the analysis area are also in the Challis Experimental Stewardship Program Area. The area was designated pursuant to the Public Rangelands Improvement Act of 1978 (43 USC 1901 *et seq.*) with the overall goal of fostering greater cooperation among the managing agencies and the Federal land users. More specific goals include providing incentives to the holders of grazing permits or leases whose stewardship results in an improvement of the range condition of lands under permit or lease, and cooperative range management projects designed to foster a greater degree of cooperation and coordination between the Federal and State agencies charged with the management of the rangelands and with local private range users (43 USC 1908).

The S. Creek IRA (06-005; 99,620 acres) is on NFS land generally north, west and south of the analysis area. North of the analysis area, the perimeter of the IRA is along the top of the Buckskin-Basin Creek ridgeline, as close as 200 feet to the MMPO area (Alternative M2). The northernmost support facilities for the TSF extend 750 feet into the IRA, which in this area also contains a network of historic mining roads (some of which are used to access the Cinnabar mining claims north of the TSF). Elsewhere, the perimeter of the IRA is typically at least 0.2 mile from the analysis area (centerline of Thompson Creek), but is adjacent to the selected land along 0.4 mile of Thompson Creek upstream of the mouth of the Pat Hughes drainage. None of the selected land is in the S. Creek IRA. Approximately 60 percent of the Challis National Forest is designated IRA, and the IRA designation does not place any restrictions on locatable mining operations.

The nearest other SMAs are the Spring Basin IRA (06-006) (700 feet northeast of the northeast corner of the selected land on the east side of S. Creek Road); Challis SRMA (1 mile south of the selected land); the Sawtooth NRA (2 miles south of the selected land); Railroad Ridge IRA (06-922) (3 miles south of the selected land); Birch Creek ACEC (10 miles northeast of the selected land); Germer Basin/Malm Gulch ACECs (11 miles northeast of the selected land); Jerry Peak, Jerry Peak West and Corral-Horse Basin WSAs (12 miles southeast of the selected land); and Frank Church River of No Return Wilderness Area (12 miles northwest of the mine) (BLM 2012b, USFS 2012d).

3.12.1.2. Recreation

The mine site – including the gated Bruno Creek, Pat Hughes, and Buckskin roads – is not open to the public. The rest of the analysis area is only accessible to the public by hiking through extremely rugged terrain (no authorized, motorized public access), apart from portions of upper Thompson Creek Road (along the southwest portion of the selected land), a short section of the lower No Name Creek Road, and S. Creek Road (the centerline of which is part of the east

boundary of the selected land except where the boundary would be the Redbird property which extends west across S. Creek Road for several hundred feet). These roads are authorized for travel all year, but the No Name Creek Road is not maintained, the upper Thompson Creek Road (north of a TCMC gate on the road near the mouth of Thompson Creek) is not maintained in the winter, and the S. Creek Road is not maintained in the winter north of the Bruno Creek access road. There is no public access across the Thompson Creek Bridge. Therefore, upper Thompson Creek Road is accessible to the public only by "North Slate Creek Road" (Forest Service Road #40040, authorized for travel all year but not maintained in the winter), which begins at the Slate Creek Bridge on SH 75. A section of the North Slate Creek Road passes through TCMC property near the mouth of Thompson Creek, but the Forest Service has an easement from TCMC for non-exclusive (administrative and public) access on this section of the road. More detailed information on transportation and access is in Section 3.16.1.

The Thompson Creek Road ends approximately 3 miles north of the selected land at the start of Trail 161 (one trail to the Custer Fire Lookout). From Trail 161, one may also reach the end of Trail 162 leading up from Cinnabar Creek. The uppermost portion of the road is fairly primitive and recreational use is very low for most of the year.

One reason for the very low recreational use is the nearby and more accessible and developed localities of the Yankee Fork Road to the west and S. Creek Road to the east. These roads provide access to numerous trails and the Yankee Fork Road provides access to several campgrounds (Camper 2010). However, even S. Creek Road receives very light vehicle roundtrips (non-TCMC) during fall, and even less vehicle roundtrips during the rest of the year. The lower S. Creek Road is part of the Tour of Idaho, a 1,600 mile dirt bike ride that begins in the Malad Range of southern Idaho and ends in the Selkirk Mountains near the Canadian border. The Tour of Idaho is very likely one of the most difficult long dirt bike rides in the US (Tour of Idaho 2013). The lower S. Creek Road receives of the order of 100 one-way trips by riders on the Tour of Idaho each summer.

No Name Creek Road (faint two-track part way up the No Name drainage) is very rarely used. The non-TCMC traffic on these roads is recreation-focused, and when it occurs it is generally on weekends. Recreation thus occurs mostly in the fall, with lesser amounts in the spring and summer, and the least recreation occurring in the winter. There are no BLM trails, campgrounds or other developed recreation sites in the analysis area. The closest BLM campground is the East Fork campground on the Salmon River approximately 7 miles east of the analysis area on SH 75. The major reasons for the very low recreational use of the analysis area are the lack of high quality recreation values, particularly since most of the area is near extensive mining operations, and the extremely rugged terrain without trails or public roads.

The recreation in the analysis area (selected land only, outside of sites developed with mining facilities) is typically hunting, camping, antler shed collection, recreational driving (highway vehicles and OHVs), hiking, and general enjoyment of the outdoors. There is very rare horseback riding, fishing, skiing, mountain biking, rockhounding, wildlife/wild flower viewing, nature photography, berry picking, backpacking, scenic viewing, etc. (Camper 2010). Most of the SCNF is open to personal use wood cutting (firewood and posts/poles) by permit. However, people rarely cut wood in the area due to the lack of dead trees at least 300 feet from water

(permit condition) that are also near roads; the distance of the area from population centers; and the rough roads leading to the area. Hunting typically occurs in only three small areas in the southwest, southeast, and northeast portions of the selected land, but hunting activity is low (e.g., few people per year). This hunting includes mountain lion hunting in the winter by one commercial outfitter with a BLM special recreation permit that includes the selected land.

The BLM has classified the BLM land in the MMPO area as *middle country* on the recreation settings matrix (RSM). The *middle country* classification indicates an area with a mostly retained natural landscape within ½ mile of motorized routes, and in which the sounds of people may occasionally be heard. The Forest Service has classified the NFS land in the MMPO area as *rural* on the ROS. The *rural* classification indicates an area with a modified natural setting in which dominant modifications are continually noticeable.

The BLM has classified the selected land on the RSM as a mixture of *back country*, *middle country*, and *front country*. The *back country* classification indicates an area with a retained natural landscape in which any modifications are not visually obvious; there are no motorized routes within ½ mile, only non-motorized use is allowed, and the sounds of people are infrequently heard. The *front country* classification indicates an area with a modified natural landscape (e.g., roads, structures, utilities, etc.) with passenger vehicle routes within ½ mile, and in which the sounds of people are regularly heard.

3.12.2. Offered Lands - Broken Wing Ranch

3.12.2.1. Land Use

The ranch, owned by TCMC, is 813 acres in Custer County. The ranch is surrounded by BLM land except for small areas of private property to the southeast and north, and ½ mile of State land along the northeast (Figure 1.3-1). There are no Federal easements, leases, or permits for land that is part of the ranch (private property). However, there are five ROWs on BLM land related to the ranch: a ROW grant to TCMC for a buried pipeline from a diversion on Lyon Creek between BWR-1 to BWR-3 (IDI-37282); a ROW grant to the IDFG for a fish screen and bypass pipeline for the diversion on Lyon Creek, and for access on Lyon Creek Road to the facilities (IDI-37303); a ROW grant to TCMC for a water pipeline to BWR-4 (IDI-16391); a ROW grant to TCMC for a pipeline extension from Sink Creek to BWR-6 (IDI-31814), and an assertation for a pre-FLPMA ditches and canals ROW from Sink Creek to BWR-6 (IDI-32227). The TCMC ROWs/ROW assertion would be moot and relinquished at title transfer. The other ROWs would be modified to include the relevant portions of the ranch. Any ROWs granted to others for land that is part of the ranch would be amended or relinquished as appropriate. The ranch is an operating cattle and agricultural ranch with a variety of associated uses (Table 2.2-1).

Residential development is steadily increasing on private land in the Salmon River corridor, including a subdivision of land that once belonged to the southeast portion of the ranch along the Salmon River. A portion of this piece of the former ranch has also been developed as a gravel pit by the ITD. The ranch is in the Upper Salmon River SRMA which comprises 42,160 acres in the following land jurisdictions: BLM land (18,860 acres, 45 %), private land (22,790 acres, 54 %), IDFG land (250 acres, 0.6 %), and IDL land (260 acres, 0.6 %). The overall management objective for the SRMA is to preserve its natural, scenic, and undeveloped qualities while

enhancing high-quality recreation opportunities (BLM 1986). The SRMA is incorporated into the Challis RMP (BLM 1999).

The portion of the Salmon River that runs through the ranch is part of an all-inclusive list of river segments designated eligible for further study for suitability for inclusion in the National Wild and Scenic River System by National Park Service in 1982 and updated in 1993 (NPS 1993). The outstandingly remarkable values for the eligibility designation are recreational, fisheries and geological, and the classification would be recreational as opposed to wild or scenic (BLM 1999, p. 77). Therefore, one of the goals of the BLM in administering land along this segment of the Salmon River is to avoid degradation to these values (BLM 1999). The portion of SH 75 along the ranch is also a part of the Idaho Salmon River Scenic Byway. Several commercial outfitters have BLM or Forest Service special recreation use permits for guided fishing and/or floating along the Salmon River, including the segment (below the ordinary high water mark) through the ranch. The eastern portions of the ranch are adjacent to the Challis Wild Horse and Burro HMA (there are no burros in the HMA), which comprises the BLM land east of SH 75, west of US Highway 93, and north of the Herd Creek-Road Creek ridgeline and East Fork Road. The BLM, NFS, and State lands in the analysis area are also in the Challis Experimental Stewardship Program Area (Section 3.12.1.1). The ranch is surrounded by two BLM grazing allotments: the Bald Mountain Allotment (~ 16,600 acres, 446 AUMs) to the west, and the Split Hoof Allotment (~ 8,520 acres, 187 AUMs) to the east.

The nearest other SMAs are the S. Creek IRA (06-005, 1.0 mile west); East Fork Salmon River Bench ACEC (1.3 miles south); Germer Basin/Malm Gulch ACECs (2.5 miles northeast); Corral-Horse Basin WSA (4 miles southeast); Railroad Ridge IRA (06-922) (4 miles southwest); Sawtooth NRA (5 miles southwest); Sand Hollow ACEC (6 miles southeast); Jerry Peak and Jerry Peak West WSAs (7 miles south); and Frank Church River of No Return Wilderness Area (18 miles northwest) (BLM 2012b, USFS 2012d).

3.12.2.2. Recreation

State Highway 75 bisects the ranch and provides direct access to the ranch parcels east of the Salmon River. The parcels west of the river are accessed by either the Poverty Flat Road (public to where a spur road intersects the ranch) from the south, or the Lyon Creek Bridge (private) to the north. There are many two-track roads throughout the ranch, and one of these roads extends 1 mile up Lyon Creek. Motorized travel is allowed on BLM land in the analysis area on most existing roads and trails. However, certain areas have seasonal motorized travel closures or are permanently closed to motorized travel, and certain roads and trails are closed to motorized travel, e.g., the Malm Gulch road is closed in the analysis area approximately 2 miles from SH 75. Snowmobiling (on authorized routes) may occur during winter. More detailed information on transportation and access is in Section 3.16.2.

Custer County is nationally recognized for river rafting, steelhead and salmon fishing, and big game hunting (BLM 1998). Recreation occurs in the analysis area throughout the year due to the somewhat mild climate of the region. The peak season for recreation is summer followed by fall (hunting). There are no public recreation opportunities on the (private) ranch. However, the past owners have enjoyed recreation on the ranch such as big game hunting, bird hunting (upland birds and waterfowl), fishing, antler shed collection, scenic/wildlife viewing and photography,

hiking, apple picking, etc. The ranch and the Federal land readily accessed via the ranch also provide excellent recreational opportunities such as small game hunting, backpacking/camping, recreational driving (highway vehicles and OHVs), antler shed collection, horseback riding, mountain biking, rockhounding, wild flower viewing, berry picking, and general enjoyment of the outdoors. In addition, there are 4.4 miles of ranch frontage along the Salmon River, which is used extensively in the analysis area for fishing and float boating (Photo 3.12-1).



Photo 3.12-1. Salmon River in front of Broken Wing Ranch (Lyon Creek Bridge).

Steelhead trout fishing occurs during October through May, with most fishing concentrated in March and early April. During this time there are hundreds of people fishing each day along the Salmon River in the Clayton-Challis-Ellis region. The end of spring marks the start of the general recreational tourist season. In recent years there has been a Chinook salmon fishing season during certain periods of time during May, June or July. During some years the Chinook salmon fishing season includes the portion of the Salmon River in the analysis area. Trout fishing, float boating, camping, sightseeing and general recreating continue through the fall when hunting begins.

The (private) ranch is not subject to any Federal recreation classifications. However, the BLM land adjacent to the ranch is classified as *rural* under the RSM, and the ranch would conform to this classification. The *rural* classification indicates a landscape considerably modified by agriculture, residential, or industrial uses (including boat launches and campgrounds). Such landscapes are generally within ½ mile of paved or primary roads, and the sounds of people can

frequently be heard in the landscapes. In many cases *rural* lands are moderately regulated with various permit and reservations systems (BLM 1998).

3.12.3. Offered Lands - Garden Creek Property

3.12.3.1. Land Use

The property (82 acres) is a forested track of private land in Bannock County. There is no active management of the property, which has not been commercially harvested or managed for grazing (Section 3.5.3). There are no Federal easements, leases, or permits associated with the (private) property. The property is surrounded by NFS land to the east and north and by BLM land to the south and west (Figure 1.3-1).

The property is in the Pocatello ERMA (558,600 acres), but the ERMA does not apply to private property. The nearest SMA is the Scout Mountain IRA, adjacent to the east side of the property. The IRA extends southwest to north except that Scout Mountain Top Road is excluded. The nearest other SMAs are Mink Creek IRA (6 miles northwest); Oregon National Historic Trail (6 miles south); Indian Rocks ACEC (6 miles northeast); Robbers Roost Creek ACEC (10 miles northeast); Petticoat Peak wilderness study area (18 miles east); and Downey Watershed ACEC (18 miles southeast) (BLM 2012b, USFS 2012d).

3.12.3.2. Recreation

The only road access to the property is Scout Mountain Top Road (Forest Service Road #009, open June 1 to November 15), which touches the north edge of the property before ending 4.1 road miles north at Scout Mountain (Section 3.16.3.). The road has two lanes with a gravel surface, and begins at South Fork Mink Creek Road (Forest Service Road #163, open May 15 to November 15). There are no roads or public recreation opportunities on the (private) property, which is visited by perhaps one or two people for less than a day each year. The Federal land near the property is relatively inaccessible and little used by the public, except for the Scout Mountain trail complex (Trail 164, Trail 184, Trail 186, and Trail 192) and trails open to motorcycles (Trail 148, Trail 178, and Trail 195) approximately 1 mile north of the property. The trail complex is at the end of Scout Mountain Top Road. There are no roads or trails in the vicinity of the property to the south and southeast, which is in the Scout Mountain IRA. More detailed information on transportation and access is in Section 3.16.3.

Recreation on the property is limited to those with permission from TCMC. However, recreation in the analysis area is typically hunting, camping, antler shed collection, recreational driving (highway vehicles and OHVs), hiking, and general enjoyment of the outdoors. There is very rare horseback riding, fishing, skiing, mountain biking, rockhounding, wildlife viewing, photography, berry picking, backpacking, etc. Hunting opportunities are big game (e.g., deer, elk, mountain lion, wolf, moose, bighorn sheep, etc.), upland birds (e.g., quail, chukar, crow, dove, partridge, grouse and pheasant), small game (e.g., rabbit/hare and furbearers), and water fowl (e.g., goose, duck, coot and snipe).

The (private) property is not subject to any Federal recreation classifications. The adjacent BLM land has not been classified on the RSM (Patterson 2011). The adjacent NFS land is classified on the ROS as semi-primitive, non-motorized (Tiller 2011), which corresponds to a natural

setting with some subtle modifications. The Garden Creek property would best match this ROS classification.

3.13. Socioeconomic Factors

The analysis area for socioeconomic factors for the MMPO alternatives is Custer County because all of the mine operations are in the county and 73 percent of the TCMC workforce resides in the county. However, Lemhi County is also briefly discussed because 19 percent of the mine workforce resides in Lemhi County. Similarly, the analysis area for the land disposal alternatives is also Custer County (selected land and Broken Wing Ranch), with a brief discussion of Bannock County (Garden Creek property); however, there would not be any substantial socioeconomic effects to Bannock County related to the land disposal.

3.13.1. Molybdenum Economics

Molybdenum reserves and production capacities are concentrated in four countries (Table 3.13-1). Molybdenum reserves at the largest (by annual production) two primary molybdenum mines in the US were 210,540 tons (Henderson mine, 7.1 % of US reserves) and 123,849 tons (TCM, 4.2 % of US reserves) in 2011 (InfoMine 2012b, Marek and Lechner 2011). The world production of molybdenum increased by 3.3 percent from 2010 to 2011. The TCM (~ 20 million pounds/year) is the fourth largest primary molybdenum producer in the world. The mine produced a record 25.3 million pounds of molybdenum in 2010, or 4.6 percent of world production and 17.9 percent of US production. However, the mine typically produces 15 million to 20 million pounds per year of molybdenum, representing 2.7 to 3.6 percent of world production and 10.6 to 14.2 percent of US production.

Table 3.13-1. World molybdenum mine production and reserves.

	Mine Production (million pounds)		Reserves (short tons)[1]	Reserves (%)
Country	**2010**	**2011**	**2011**	**2011**
China	206.36	207.24	4,740,000	43.0
US	130.96	141.1	2,980,000	27.0
Chile	0.82	83.78	1,320,000	12.0
Peru	37.48	39.68	500,000	4.5
Other	76.72	79.36	1,480,000	13.4
World TOTAL	**533.52**	**551.16**	**11,020,000**	**100.0[1]**

[1] total is correct but sum of individual values does not total exactly due to independent rounding (USGS 2012a)

The molybdenum price (for "tech moly," MoO_3) is expected to be approximately $15 and $20 per pound during the next two decades, but in the last decade has ranged from an annual average of $2.36 per pound in 2001 to $30.30 per pound in 2007. The spot price is currently $11 per pound (in November 2012), and will continue to be highly cyclical. Molybdenum consumption historically has had a strong growth rate of approximately 4 percent per year, and the growth rate is expected to be 4 to 5 percent per year during the next two decades. The growth rate is driven primarily by consumption in China (Gardner 2008). The TCM production

to date is worth $6.8 billion at a typical price of $17.50 per pound. The mine is expected to produce 73 million pounds of molybdenum during 2012 through the middle of 2016 (Alternative M1).

3.13.2. Socioeconomic Factors by County and Offered Lands

TCMC is the largest employer in Custer County and typically has 400 employees distributed among the mine, mill and administration. Approximately 73 percent of these employees reside in Custer County (Idaho Economics 2008, projected data). TCMC had approximately 390 employees in 2011 with a payroll of $27.4 million and additional benefits of approximately $11.0 million (Doughty 2012).[21] TCMC is actively involved with and is a financial supporter of many groups and events in Custer County.

The mine is a major contributor to the economy of both Custer County and Idaho. Approximately one out of every five payroll jobs in Custer County in 2009 were as direct employees of TCMC. The TCMC payroll in 2011 of $27.4 million was 46.9 percent of all 2010 payroll wages in the county. TCMC also purchased $68 million of goods and services in Idaho and $133.4 million in the US and Canada in 2010. Approximately $17 million was spent in Custer County. Purchases from businesses in Lemhi County totaled $1.2 million in 2009 (Idaho Economics 2008, projected data).

The mine is a major source of tax revenue for Custer County from taxes paid by TCMC on real property and net profits of its mining operations. For example, the taxes paid by TCMC in 2010 ($807,921) were 27.8 percent of the total property tax collections in 2010 in the county (Doughty 2012, ISTC 2012a, James 2012). In addition, TCMC employees paid property taxes estimated in 2011 as $90,000 in Custer County and $25,000 in Lemhi County, as well as other local taxes such as vehicle registration fees. Note that despite the steady production in any mine plan, mining operations are cyclical due to the cyclical prices of commodities in the world market.

3.13.2.1. Custer County

Custer County is a large rural county in central Idaho. The county comprises 4,921 square miles (3rd among Idaho counties) and is sparsely populated with just 4,368 people in 2010 (38th among Idaho counties), or 0.89 person per square mile in 2010 (2nd among Idaho counties) (US Census Bureau 2012c). Most of the county is Federal land (Table 3.13-2). The county population has been nearly constant since 2000. In contrast, the Idaho population increased during 2000 to 2010 by 21.1 percent (US Census Bureau 2012b). The four cities in the county are Challis (county seat), Mackay, Stanley, and Clayton. The county has no metropolitan areas, and is distant from urban areas with most residents (61.8 %) living in unincorporated areas (Table 3.13-3.) (US Census Bureau 2012b). The county has no traffic stop lights.

The county has been dominated by mining, agriculture, and ranching since the county was created in 1881. The county is highly dependent on mining jobs which are distinctly cyclical due to the inherent volatility of commodity prices. For example, mining accounted for 18 percent of

[21] As an example of the cyclical nature of mining, the mine is expected to enter a slowdown at the end of 2014 with no molybdenum production and only 52 employees (Challis Messenger 2014).

all payroll jobs in the county in 1998, and there were more than 500 new residents when development of the TCM began in 1980, and 300 residents left the county when the Hecla Grouse Creek mine closed in April 1997. By 2002 mining accounted for just 8 percent of all payroll jobs. Since then the share of mining payroll jobs has steadily increased to 21 percent in 2009, with almost half of the county payroll jobs occurring in government and mining. Most recently, TCMC laid off 105 employees in October 2012 (TCMC 2012a). Other important cyclical events in the county are large-scale forest fires (IDLR 2012a, 2012b).

Table 3.13-2. Custer County land jurisdiction (legal acres).

Land Jurisdiction (2000)	(acres)	(%)
Federal lands	2,937,675	93.19
BLM	813,965	25.82
National Forest System	2,123,710	67.37
National Parks Service	0	0.00
Tribal lands	0	0.00
State lands	53,901	1.71
Endowment lands	52,626	1.67
Fish and Game	1,253	0.04
Parks and Recreation	22	0.00
Private	158,503	5.03
County	2,300	0.07
City	5	0.00
Water	5,720	0.18
TOTAL[1]	**3,152,384**	**100.0**

[1] except water and indented subcategories, e.g., BLM under Federal lands
EPS-HDT (2011), IDC (2012)

Table 3.13-3. Custer County population data.

Geographic Area	1980	1990	2000	2010
Challis	758	1,079	909	1,081
Clayton	43	26	27	7
Mackay	541	574	566	517
Stanley	99	71	100	63
Unincorporated	1,944	2,407	2,740	2,700
Custer County	**3,385**	**4,157**	**4,342**	**4,368**

IDLR (2012a), US Census Bureau (2012b, 2012d, 2012e)

Demographics and Employment

The age structure of the county has shifted toward an older population since 2000, e.g., persons of retirement age (≥ 65 years) accounted for 14.5 percent of the population in 2000, and 18.7 percent of the population in 2010, substantially higher than the Idaho value of 12.4 percent in 2010. Consequently, the median age in the county increased from 41.2 in 2000 to 48.0 in 2010. Over this same period the working age population (ages 18 to 64) increased marginally by 3.4 percent. Such a small increase is probably mostly the result of limited job opportunities in the county with working age persons leaving to seek employment elsewhere. The aging population and near constant working age population has resulted in a distinct decline of 34.5 percent in the school age population (ages 5 to 18) from 2000 to 2010, and a decline of 6.4 percent in persons under the age of 5 (Table 3.13-4).

Table 3.13-4. Custer County demographics.

	2000	2010	2000 Population (%)	2010 Population (%)	Change (%)
Total Population	4,342	4,368			-0.6
Median Age	41.2	48.0			16.5
< 5 years	234	219	5.4	5.0	-6.4
5-17 years	641	420	14.8	9.6	-34.5
18-64 years	2,603	2,692	59.9	61.6	3.4
> 64 years	630	818	14.5	18.7	29.8
Male	2,219	2,318	51.1	53.1	4.5
Female	2,123	2,050	48.9	46.9	-3.4

US Census Bureau (2012f, 2012g)

Custer County is predominately white (96.4 %), with a small Hispanic/Latino population (4.0 %). The race and ethnicity of the county has changed little during 2000 to 2010, except for large percentage increases in Asian, Native Hawaiian/Pacific Islander and American Indian/Alaska Native populations (Table 3.13-5).

Table 3.13-5. Custer County race and ethnicity.

	2000		2010		Change
	(#)	(%)	(#)	(%)	(%)
Not Hispanic or Latino	4,159	95.8	4,192	96.0	0.8
Hispanic or Latino	183	4.2	176	4.0	-3.8
POPULATION OF ONE RACE					
White	4,224	97.3	4,209	96.4	-0.4
Black of African American	0	0.0	8	0.2	NA
American Indian, Alaska Native	24	0.6	27	0.6	12.5
Asian	1	Z	10	0.2	900.0
Native Hawaiian/Pacific Islander	1	Z	4	0.1	300.0
Other	51	1.2	66	1.5	29.4

Z = Value is greater than zero, but less than half of smallest unit shown (US Census Bureau 2012f, 2012g)

The median household income (unadjusted for inflation) in the county increased from $32,174 to $41,910 during 1999 to 2010, and the value in 2010 was somewhat lower than the average of $46,423 for Idaho in 2010. The per capita income increased from $15,783 to $22,625 during 1999 to 2010, similar to the value of $22,518 for Idaho in 2010. The percentage of people living in poverty in the county decreased from 14.3 percent to 13.8 percent during 1999 to 2010, and the 2010 value was slightly higher than the average of 13.6 percent for Idaho in 2010 (US Census Bureau 2012c) (Table 3.13-6).

Table 3.13-6. Custer County income and poverty.

	1999	2010	Change
	($)	($)	(%)
Median household income	32,174	$41,910	30.3
Per capita income	15,783	$22,625	43.4
	%	%	%
Population living in poverty	14.3	13.8	-0.5

US Census Bureau (2012c)

The unemployment rate in Custer County was higher than that of either Idaho or the US early in the last decade. The rate dipped in 2003 to match the State and national rates, and then slipped below both rates. The civilian labor force steadily decreased from 2001 to 2006 and has changed little since. The unemployment rate of 3.2 percent in 2007 was the lowest in the past decade, but has risen since then due to the national recession (IDLR 2012a) (Table 3.13-7). Seasonally unadjusted unemployment peaked at 11.2 percent in January 2011, and is currently (January 2012) at 10.5 percent (BLS 2012a).

Table 3.13-7. Custer County labor force and unemployment trends.

	2001	2003	2005	2007	2009	2011
Civilian labor force	2,692	2,523	2,568	2,324	2,664	2,507
% of labor force unemployed	6.0	6.0	4.7	3.2	5.3	7.7

IDLR (2012a)

The dominant employment sectors in the county are government, mining, leisure and hospitality; and trade, utilities and transportation (Table 3.13-8). Almost every sector had job losses in 2009 compared to 2008, with the largest declines in the leisure and hospitality, mining, and construction. The leisure and hospitality sector and the construction sector lost seven and four jobs, respectively, in 2010, whereas the mining sector gained 33 jobs. Approximately half of the covered jobs in the county were in the government and mining sectors in 2010.

Table 3.13-8. Custer County average annual wage by industry sector.

Industry Sector	2000 ($)	2009 ($)	2010 ($)	Total 2010 ($)	2010 (%)
Agriculture	17,331	20,828	21,632	778,752	1.3
Mining	ND	63,401	67,244	25,956,184	44.4
Construction	38,108	29,090	31,099	1,492,752	2.6
Manufacturing	15,092	ND	41,149	123,447	0.2
Trade, utilities and transp.	16,397	21,425	22,568	5,438,888	9.3
Information	30,467	41,855	45,139	1,399,309	2.4
Financial activities	13,845	16,748	18,354	936,054	1.6
Prof. and business services	17,387	28,418	34,596	1,971,972	3.4
Edu. and health services	9,096	15,612	17,289	1,071,918	1.8
Leisure and hospitality	12,179	13,691	13,465	3,595,155	6.2
Other services	25,095	31,172	31,093	684,046	1.2
Government	26,983	31,938	32,665	15,385,215	26.3
TOTAL	**23,655**	**32,248**	**34,913**	**58,409,449**	**100**[1]

[1] total is correct but values do not sum to exact total because of independent rounding (IDLR 2012a)

The average covered wage in the county was $34,913 in 2010, an increase of 8.3 percent compared to in 2009. The average wage increased at an annualized rate of 3.9 percent during 2000 to 2010 (Table 3.13-8). The largest decline in the wage for a sector during the last decade was in mining which decreased by 18 percent ($77,338 to $63,401) from 2008 to 2009. The mining sector wage peaked at $84,082 in 2006, and the sector comprised 44.4 percent of all wages in the county in 2010. The average wage paid by TCMC in 2011 was $70,284, twice the average 2010 wage (2011 data not yet available) of the county, and the TCMC payroll of $27.4 million (390 employees) was 46.9 percent of the total 2010 wages (2011 data not yet

available) in Custer County. Wages in the mining sector are higher than all other industry sectors and almost twice the average for all jobs in the county. The mining sector is essentially the payroll base of the county (IDLR 2012a) (Table 3.13-8). In addition to the wages, TCMC also provides its employees benefits that are approximately 40 percent of their wages.

Total personal income (TPI) in the county was $135.1 million in 2008, a gain of $9.6 million (7.7 %) from 2007. In contrast, TPI for Idaho increased by 2.4 percent in 2009. Net earnings (adjusted for residence of workers) were $74.7 million (55.3 % of TPI) in 2008. Income from dividends, interest and rent was $35.8 million (2.5 %) followed by personal current transfer receipts (PCTRs) of $24.6 million (18.2 %). Compared to Idaho, earnings comprise a much smaller share of the county TPI and a slightly larger share of PCTRs. The changing economic base of the county is evident by changes in the sources from which personal income is derived. For example, in 1990 net earnings were 66.1 percent of TPI, dividends, interest and rent were 22.5 percent, and PCTRs were 11.4 percent (BEA 2012).

Per capita personal income in the county increased 5.4 percent from $30,545 in 2007 to $32,203 in 2008. In contrast, per capita personal income in Idaho increased 0.5 percent from $32,837 in 2007 to $32,994 in 2008. Income from PCTRs has been increasing more quickly than all other sources of income in the county, e.g., an annualized increase of 6.9 percent during 2000 to 2008. In comparison, the annualized increase in income from earnings was 3.3 percent during 2000 to 2008, and the annualized increase in dividends, interest, and rent during this time period was 4.0 percent (BEA 2012). The PCTRs component of personal income is primarily retirement and disability insurance benefits (e.g., 47.0 % in 2008) and medical benefits (e.g., 37.5 % in 2008) (BEA 2012).

Government Funds

The finances of the county comprise the revenues and expenditures of county government. Total revenue was $4.75 million in 2009, composed of revenue from local sources ($2.55 million, 53.7 %) and intergovernmental transfers ($2.20 million, 46.4 %). The revenue from local sources was primarily from property taxes ($1.21 million, 47.5 %) and payments in lieu of taxes (PILTs) ($898,234, 35.2 %). County expenditures were $3.93 million primarily for general government ($1.70 million, 43.2 %), street and road maintenance ($0.98 million, 24.9 %), and public safety ($0.84 million, 21.5 %) (Custer County 2010).

Property taxes are collected by *taxing districts*, an entity authorized by law to levy taxes to provide services to residents of the district. In addition to Custer County, there are approximately 20 taxing districts in the county including cities, schools, cemeteries, highways, ambulance, abatements, and fire districts. The Custer County blended (urban and rural) property tax rate for all taxing entities in the county (including county government) is typically the lowest tax levy in Idaho, i.e., 0.36 percent versus 1.29 percent in 2011 (ISTC 2012b). The selected land is in Custer County Tax Code Area 07 and Tax Code Area 50, which have an approximate levy rate of 0.2 percent. The Broken Wing Ranch is in Custer County Tax Code Area 11 with a levy rate of approximate 0.25 percent (James 2012). The net profits of the tax on TCMC are part of property taxes in Idaho, and are based on the valuation of net mining profits. These profits are treated as personal property and taxed at the same rate as other real and personal property.

The mine is a substantial source of property tax revenue in Custer County. TCMC pays tax on its real property as well as its net profits, amounting to $807,921 in 2010 (including $437,123 net profits tax) or 27.8 percent of all property taxes collected by the county (Doughty 2012, James 2012). Increases or decreases in the net profits tax distinctly affect the amount of property tax borne by residential property owners. During boom periods, TCMC has paid as much as one-third of the county property tax bill. The property tax paid by the TCMC for government services is dispersed throughout the county, but the property taxes paid by TCMC to other taxing districts in north Custer County remain in that area. To the extent that taxing districts in north Custer County are unable to find other sources of revenue, they will rely on increasing property taxes to make up the difference by increasing their tax levies (James 2010, Challis Messenger 2010).

Recognizing the inability of local governments to collect property taxes on Federally-owned land, Congress enacted the Payment in Lieu of Taxes (PILT) Act in 1976 (31 USC 6901-6907). The act provides for payments to local governments containing certain types of Federal lands to help compensate the counties for tax revenue that cannot be collected on Federal lands, yet such lands may still have demand for services such as fire protection, police, longer roads to skirt Federal lands, etc. Due to the relatively large size and small population of Custer County, the PILT for the county has always been calculated as the county population multiplied by the payment cap, and totaled $687,385 in 2011 (Table 3.13-9.) (Corn 2011, USDOI 2012).

Table 3.13-9. Custer County PILT.

Year	PILT ($)	PILT (acre)
2000	216,188	2,937,675
2001	327,901	2,936,739
2002	344,225	2,936,769
2003	380,688	2,936,754
2004	391,379	2,936,679
2005	390,504	2,935,550
2006	400,357	2,935,450
2007	394,676	2,935,965
2008	641,630	2,935,740
2009	655,924	2,935,636
2010	683,585	2,935,636
2011	687,385	2,935,509

USDOI (2012)

Changes in the number of Federal acres would affect a PILT only if the PILT were calculated using Method 1 or Method 2 (Table 3.13-10.) because of the population payment cap provision. Accordingly, Custer County would need to lose 852,525 qualified Federal acres before the county PILT would be affected (Table 3.13-10).

Housing and Agriculture

Housing in Custer County consists of owner and rental housing units with very high vacancy rates (37.6 % in 2010). A large percentage of the vacant units (79.5 % in 2010) are classified as seasonal, recreational, or occasional use units (Table 3.13-11). The majority of the units are single family units, with rental units comprising a small percentage (4.7 % in 2000) of the total units. Much of the housing stock in 2010 (95.0 %) was built prior to 2000, with 60.4 percent of the stock built during 1970 to 1999 (US Census Bureau 2012f, 2012g).

There has been little residential construction in the county since 2000, with just 49 building permits (47 for single-family units) issued in the county during 2001 to 2009 (US Census Bureau 2010). No permits were issued in the county during this time period for low-income or high-density housing. Housing stock in the county increased from 2,986 in 2000 to 3,036 in 2008, including new construction and other units such as mobile homes. The increase of 1.7 percent in housing stock is in sharp contrast to the increase in Idaho of 21 percent during the same period (US Census Bureau 2012f).

Table 3.13-10. PILT sample calculations for 2011 (legal acres).

Method 1	
Qualified Federal lands (acres)	2,935,509
2011 rate	$2.42
Deductions for Federal lands receipts[1]	$0.00
PILT	$968,718
Method 2	
Qualified Federal lands (acres)	2,935,509
2011 rate	$0.33
PILT	$968,718
Population Payment Cap	
Population	4,218
Per capita payment	$162.9765
Maximum PILT	$687,385
Loss in Acres Necessary to Affect PILT	
Maximum PILT	$687,385
2011 rate	$0.33
Qualified Federal lands to equal maximum PILT (acres)	2,082,984
Current qualified Federal lands (acres)	2,935,509
Loss necessary to affect PILT (acres)	852,525

[1] Custer County receives negligible Federal land receipts.

Table 3.13-11. Custer County housing occupancy.

	2000		2010	
	(#)	(%)	(#)	(%)
Housing units	2,983	100.0	3,103	100.0
Occupied	1,770	59.3	1,936	62.4
owner-occupied	1,326		1,471	
renter-occupied	444		465	
Vacant	1,213	40.7	1,167	37.6
for seasonal/recreation/occasional use	747		928	

US Census Bureau (2012f, 2012g)

The number of farms in the county has been relatively constant since at least 1992, but the average farm size has decreased from 527 acres in 1992 to 476 acres in 2007. During this period the total farmland declined 11.7 percent from 140,701 acres to 124,191 acres. Although agriculture plays a large role in the identity and social life of the county, outside employment is commonly necessary to augment household farm income (Table 3.13-12.) (USDA 1992, 1997, 2002, 2007). Land used for ranching has experienced considerable pressure for subdivision and development as retired people and quality-of-life-focused people have moved into the upper Salmon River Valley and purchased retirement and recreation homes.

Table 3.13-12. Custer County agricultural overview.

	1992	1997	2002	2007
Number of farms	267	268	285	261
Land in farms (acres)	140,701	147,913	131,571	124,191
Average size of farms (acres)	527	552	462	476
Primary Occupation of Principal Operator				
Farming	167	145	170	134
Other	100	123	115	127

USDA (1992, 1997, 2002, 2007)

Education

There are two school districts in the county: Challis Joint School District #181 (4 schools) and Mackay Joint School District #182 (2 schools) (IDE 2010a). Total enrollment in public schools in the county was 630 during the 2009 to 2010 school year (IDE 2010a). The decline in the percentage of the population under the age of 18 is reflected in declining school enrollments, and enrollments in both school district are at their lowest levels since the mid-1990s (Table 3.13-13.) (IDE 2010b). A portion of the decline in both districts is due to the Hecla Mine closure in 1997.

Public Services

Custer County has a fully developed basic infrastructure with numerous public and semi-public facilities and services including law enforcement, fire protection, water supplies, waste disposal, electricity service, and communications. Electricity is the primary power source for the county and is provided by two cooperatives: Lost River Electric Cooperative (LREC) and Salmon River Electric Cooperative (SREC). The SREC also operates and maintains a 230 kV transmission line, substations, and various transmission lines for TCMC (SREC 2012). TCMC is the largest consumer of electricity in the county, using two-thirds of the total electrical load or about 220,000 MW-hours of electricity annually; a typical house in Idaho uses 12,500 kW-hours annually (EIA 2011). Most of the electricity used by TCMC is purchased by the SREC from the Bonneville Power Administration (Dizes 2010).

Table 3.13-13. Custer County fall school enrollments.

	Challis Joint District		Mackay Joint District	
School year	Enrollment	Change	Enrollment	Change
2009-2010	411	-28	219	10
2008-2009	439	-28	209	-4
2007-2008	467	5	213	-20
2006-2007	462	14	233	-14
2005-2006	448	-13	247	19
2004-2005	461	-48	228	4
2003-2004	509	-11	221	-25
2002-2003	520	-38	246	-12
2001-2002	558	-37	258	-19
2000-2001	595	-10	277	-7
1999-2000	605	-33	284	-1
1998-1999	638	-11	285	-21
1997-1998	649	-51	306	19
1996-1997	700	-5	287	-7
1995-1996	705	--	294	--

IDE (2010a, 2010b)

Offered Lands

The property tax revenue to Custer County from the Broken Wing Ranch was $2,070 in 2009. The Garden Creek property (tax parcel R4221000302) is in Bannock County Tax Code Area 19 with an approximately levy rate of 1.3 percent (Bannock County 2012). The average market price for cattle in 2012 in Idaho was $1,230 or $102.50 per AUM assuming 12 AUMs input (USDA 2012a). In Idaho in 2011 the average private grazing fee was $14.50 per AUM (USDA 2012b), and the average local hay price during September 2012 through May 2013 was $194 per ton ($77 per AUM) (USDA 2013). The BLM grazing fee in 2012 was $1.35 per AUM.

The property tax revenue to Bannock County from the Garden Creek property was $100 in 2009. Bannock County is one of the most populated counties in Idaho with a well-diversified and growing economy. The county population increased from 75,565 in 2000 to 82,839 in 2010. Total employment in the county in December 2010 was 36,713 and the unemployment rate was 8.7 percent, below the Idaho rate 9.8 percent. The median household income was $44,848 and 14.0 percent of the population was below the poverty level in 2010, compared to 13.6 percent for Idaho (IDLR 2012a, US Census Bureau 2012h).

3.13.2.2. Lemhi County

The socioeconomic effects of the project would be concentrated in Custer County, but Lemhi County would experience some minor socioeconomic effects. Lemhi County is a large rural county north of Custer County in central Idaho comprising 4,564 square miles (4th among Idaho counties) with a population density of only 1.74 persons per square mile in 2010 (6th among Idaho counties). The population was 7,936 in 2010 (32nd among Idaho counties). The county has only two cities: Salmon with a population of 3,112 in 2010, and Leadore with a population of 105 in 2010 (IDLR 2012c, US Census Bureau 2012a, 2012b).

The county has been highly dependent on mining for most of its history, as reflected by economic trends over the past decade. For example, mining employment was approximately 18 percent of all non-farm jobs in the county in 1999. With the closure of the Beartrack Mine near Leesburg, mining employment was only 47 percent by 2006, but increased to 85 percent in 2008 due to increased activity at the Idaho Cobalt Mine between Challis and Salmon and the TCM (~ 70 % of the employees of TCMC live in Custer County) (Chabra 2010, IDLR 2012c, 2012b, US Census Bureau 2012a).

The unemployment of the county was 11.4 percent in 2011. Seasonally unadjusted employment reached 15.4 percent in February 2011, and is currently (January 2012) 14.3 percent (BLS 2012a). The per capita income in 2010 was $21,699, and the average wages of mining jobs in 2009 were $78,988 (IDLR 2012c, US Census Bureau 2012a, 2012b). In the past several years Lemhi County has embarked on diversification efforts to help offset the cyclical ("boom-bust") nature of the mining industry. These projects include a business incubation center, a large hospital, and the Sacajawea Education and Interpretive Center (IDLR 2012c).

3.13.3. Non-market Environmental Monetary Values

Monetary value can theoretically be placed on items not traded in markets such as the quality of air, cultural resources, fisheries, public access, recreation opportunities, vegetation, water, wildlife, etc. Such *non-market* monetary value may be inferred by three general approaches: market price, circumstantial evidence, or surveys. There are a variety of methods for each of these approaches. For example, in the market price approach the travel cost method infers the (minimum) value of a particular recreation site by assuming the value is equal to the cost of traveling to the site for the relevant population. However, all of the methods have substantial limitations, including extreme complexity for all but the simplest situations (e.g., Pearce et al. 2006, Venn and Calkin 2011). In addition, some of the methods are highly controversial (Arrow et al. 1993).

3.14. Tribal Treaty Rights and Interests

The analysis area for tribal treaty rights and interests for the MMPO alternatives and the selected land component of the land disposal alternatives is the Federal lands in the BLM Challis Field Office area and in the SCNF. The analysis area for the offered lands component of the land disposal alternatives is the BLM land in the Challis Field Office area (for the Broken Wing Ranch) and the BLM land in the Pocatello Field Office area (for the Garden Creek property).

American Indians and Alaska natives have a special and unique legal and political relationship with the Government of the US as defined by history, treaties, statutes (e.g., American Indian Religious Freedom Act of 1978), Executive Orders (EO 12898, EO 13007, EO 13175, SO 3206), court decisions, and the US Constitution. Treaties are negotiated contracts made pursuant to the Constitution of the US and take precedence over any conflicting State laws. The trust responsibility of the Federal government includes an obligation to protect and preserve treaty rights.

The Federal Government has a unique trust relationship with Federally-recognized American Indian tribes including the Shoshone-Bannock Tribes and the Nez Perce Tribe. More specifically, the Federal Government has a responsibility and obligation to consider and consult on potential effects to natural resources related to the tribal treaty rights or cultural use. Formal Government-to-Government consultation and informal coordination with the tribes is summarized in Chapter 6. Resources or issues of interest to the tribes that could have a bearing on their traditional use and/or treaty rights include tribal historic and archaeological sites, sacred sites and traditional cultural properties, traditional use sites, water, fisheries, traditional use plant and animal species, vegetation (including weeds), air and water quality, wildlife, access to lands and continued availability of traditional resources, land status, and the visual quality of the environment.

The MMPO area, selected land, and the offered lands are all in eastern Idaho, which is recognized by the Shoshone-Bannock Tribes as part of their aboriginal homeland and subsistence ground, and land for which the Shoshone-Bannock Tribes have treaty rights. The Nez Perce Tribe also has treaty rights on this land. Therefore, tribal treaty rights, as defined, are applicable to the project area. The natural characteristics of the land are ethnographically important; they are tied to lifeway values inseparable from the culture. The lands provided wildlife, plants, waters, travel ways, and other elements of aboriginal subsistence. These lands provide resources also important in contemporary and traditional cultural use, perhaps with a greater emphasis placed on natural character, solitude, and spiritual retreat. The current condition and nature of affected resources associated with these tribal rights and interests are described in the other sections of this chapter. Tribal treaty rights pursued on unoccupied Federal lands in the analysis areas include fishing for anadromous and resident game fish species, hunting large and small game, and gathering natural resources for subsistence and medicinal purposes.

3.14.1. Shoshone-Bannock Tribes

The Fort Bridger Treaty of July 3, 1868 (15 Stat. 673), between the US and the Shoshone-Bannock Tribes, reserves the right of the Tribes to hunt, fish, gather, and exercise other traditional uses and practices on unoccupied Federal lands. In addition, the Shoshone-Bannock Tribes have the right to graze Tribal livestock and cut timber for Tribal use on those lands of the

original Fort Hall Indian Reservation that were ceded to the Federal government under the Agreement of February 5, 1898, ratified by the Act of June 6, 1900 (31 Stat. 672).

The Fort Hall Indian Reservation (540,764 acres in 2010) (SBT 2013), home of the Shoshone-Bannock Tribes, is in southeast Idaho between the cities of Pocatello (population 58,255) to the south and Blackfoot (population 11,899) to the north (US Census Bureau 2012b). The Reservation economy exhibits unemployment and household poverty levels far greater than the average unemployment and poverty levels for the US, Idaho, or four surrounding counties. Given the poverty level of the majority of people living on the Reservation, it is possible that resources hunted for, fished for, or gathered in the analysis areas through the exercise of Tribal treaty rights could be an important or essential component of personal subsistence for Tribal members. In addition to contributing to the economic subsistence of Tribal members, resources from the analysis areas have important social and cultural values to the Tribes.

Due mostly to privacy issues, only a few "traditional use sites" have been documented through consultation with the Shoshone-Bannock Tribes. For the effects analysis in Chapter 4, it is assumed that the BLM and NFS lands were, and are, used for traditional practices such as hunting, fishing, and gathering. It is also assumed that Tribal members utilize these Federal lands for traditional activities such as ceremonies and religious practices. The following information is from "Shoshone-Bannock Tribes" published by the Shoshone-Bannock Tribal Cultural Committee and Tribal Elders.

> *Spirituality and religious ceremonies have always played a significant role in Indian cultures. Natural resources played an integral part of these ceremonies. Items such as sweet sage and tobacco made from a variety of plants were and are used in ceremonies. The Indians gathered many plants for medicinal purposes, including chokecherry, sagebrush, and peppermint. A myriad of other plants were gathered for food and to provide shelter. Rocks and clays were also used for ceremonies, ornamentation and shelter. Some bands inhabiting the upper Snake region were known as the "sheepeaters" since bighorn sheep were a staple of their diet. Buffalo, elk, deer and moose were also hunted and used by the aboriginal people. The Shoshone and Bannock bands also relied on upland game birds and small mammals. Salmon fishing was an integral part of aboriginal culture. Geysers, thermal pools and other water features were also utilized heavily by the Shoshone-Bannock Tribes.*

These traditional and subsistence activities are still practiced today across eastern Idaho although the extent of those activities is unknown. Many Tribal members hunt, fish, and gather for subsistence and to maintain their traditional way of life.

3.14.2. Nez Perce Tribe

The Camp Stevens Treaty of June 11, 1855 (12 Stat. 957), between the US and the Nez Perce Tribe, reserves the right of the Tribe to hunt, fish, gather, and exercise other traditional uses and practices on unoccupied Federal lands. The MMPO area and the selected and offered lands are

not in lands traditionally used by the Nez Perce Tribe, nor are in the typical area-of-interest of the Tribe (ICBEMP 1995). However, eastern portions of the SCNF are in the typical area-of-interest of the Tribe. In addition, the Tribe is interested in the MMPO alternatives because of potential affects to anadromous fish, which migrate to lands traditionally used by the Tribe.

3.14.3. MMPO Area and Selected Land

There are 793,081 acres of BLM land in the Challis Field Office area and 4,235,940 acres of NFS in the SCNF. In each of these jurisdictions the Federal lands are nearly all (98 to 99 %) unoccupied, i.e., subject to tribal treaty rights. Occupied lands include roads, campgrounds, ROWs, mining, etc., but not mining claims for which there is no authorized mining (Gardner 2011a). All of the BLM and NFS lands in the MMPO area are/would be occupied Federal lands (i.e., Alternative M1, ~ 630 acres; Alternative M2, ~ 980 acres, Alternative M3, ~ 1,150 acres). Approximately 450 acres (9 %) of the selected land is occupied by the mine. The nearest tribal reservation to the mine and selected land is the Fort Hall Indian Reservation, 126 miles to the southwest.

3.14.4. Offered Lands - Broken Wing Ranch

The Challis Field Office area contains 792,567 acres of BLM land (BLM 1998), of which 98 to 99 percent is unoccupied. The ranch has been private property since the early 1900s and therefore is not currently subject to tribal treaty rights. Approximately 240 acres (30 %) of the ranch would be unoccupied land (i.e., not developed or cultivated) if the ranch were Federal land. The nearest tribal reservation to the ranch is the Fort Hall Indian Reservation, 120 miles to the southeast.

3.14.5. Offered Lands - Garden Creek Property

The Pocatello Field Office area contains 613,800 acres of BLM land (BLM 2012a), of which approximately 98 percent is unoccupied Federal land. The Garden Creek property has been private since 1919 and thus is not currently subject to tribal treaty rights. All of the property would be unoccupied Federal land (i.e., subject to tribal treaty rights) if the property were Federal land. In such case, the Shoshone-Bannock Tribes would also have the right to graze Tribal livestock and cut timber for Tribal use on the property, because the property is within the ceded boundary of the Fort Hall Indian Reservation (239,837 acres ceded in 1889 and 418,560 acres ceded in 1900) (SBT 2013).

3.15. Cultural Resources

The analysis area for cultural resources for the MMPO alternatives is the MMPO area and a buffer zone extending 1 mile outward around the area. The analysis area for cultural resources for the land disposal alternatives is the selected and offered lands and buffer zones extending 1 mile outward around the lands.

Cultural resource sites are defined as any location of past human activity identifiable through field survey, historical documentation, and/or oral evidence. Cultural resource sites have many values and provide data regarding past technologies, settlement patterns, subsistence strategies, and many other aspects of history. The term "cultural resources" can apply to "those parts of the physical environment – natural and built – that have cultural value of some kind to some

sociocultural group." The term includes archaeological resources, historic resources, Native American cultural items, historical objects, spiritual places, religious practices, cultural uses of the natural environment, community values, or historical documents (King 1998, pp. 7, 9).

The term "heritage resources," used by the Forest Service, encompasses not only cultural resources but also traditional and historic use areas by all groups (Native Americans, Euro-Americans, etc). Heritage resources include lifeways or the way humans interact and survive within an ecosystem. Objects, buildings, places, and their uses become recognized as "heritage" through conscious decisions and unspoken values of particular people, for reasons that are strongly shaped by social contexts and processes (Avrami et al. 2000). Heritage resources define the characteristics of a social group (i.e., community, families, ethnic group, disciplines, or professional groups). Places and objects are transformed into "heritage resources" through values that give them significance. Public disclosure of the location of cultural resource sites (i.e., historic properties under the NHPA) is generally prohibited under 16 USC 470hh(a); this prohibition protects sensitive cultural resources from potential vandalism and other harm.

3.15.1. MMPO Area and Selected Land

Twenty-six cultural resource inventories have been conducted in the analysis areas (Table 3.15-1). A project-specific cultural resource inventory of the selected land was conducted by Smith (2009). At the request of the Idaho State Historic Preservation Office (SHPO), an attempt was made during this inventory to relocate previously recorded prehistoric sites within the permitted mine area including one prehistoric site (10CR325) located just outside the MMPO and selected land boundary on Forest Service land. In addition, previous inventories and associated data were summarized by Hearne (2008). The previous inventories (Table 3.15-1.) documented 24 cultural sites (Table 3.15-2). Twelve of these sites are in the MMPO area and selected land, and all except for one site (10CR758) have been determined as not eligible for the NRHP with SHPO concurrence (SHPO 2011). The Cinnabar/Bruno Creek Mine/ lithic scatter (10CR758) has been determined to be eligible for the NRHP and a portion of the site would be located within the MMPO area. Eleven sites are in the currently permitted mine area and area that was disturbed by mining activities; these sites were determined ineligible by SHPO in 1981 (SHPO 2011) and were not relocated during the project-specific inventory (Smith 2009). Two other sites were determined eligible for the NRHP (SHPO 2011); one is located on a privately owned in-holding and the other is near the selected land.

Table 3.15-1. Previous cultural resource inventories, MMPO and selected land

Project Number	Year	Project Name	Author	Inventoried (acre)
Not applicable (NA)	1974	Antiquities Assessment of the Cypress Mining Region	Max Pavsic	Unknown
NA	1977	Archaeological Inventory of Challis Planning Unit, Bureau of Land Management	Terrence Epperson	Unknown
NA	1979	Cultural Resource Inventory of the Proposed ROW for the 269kV Moore Substation to S. Creek	Robert Butler	1,200+

Project Number	Year	Project Name	Author	Inventoried (acre)
		Salmon Electric Co-Op power line		
CRM-CH-0039	1979	Cultural Resource Inventory of the Cyprus Mines Mineral Exploration Roads and Drill Sites	Marion McDaniel	5
CH-79-47	1979	Thompson Creek-Cyprus Mines Project	George Rubelmann and Joseph Moore	Unknown
CRM-CH-47	1980	Cultural Resource Update of the Thompson Creek-Cyprus Mine Project	Jerry Wylie and Marion McDaniel	NA
CH-80-0064	1980	Thompson Creek C&H Allotment Fencing	Marion McDaniel	1
CH-80-0065	1980	Cultural Resource Inventory of the Cyprus Mines Roads	Marion McDaniel	Unknown
ID4C81035 CH-81-0076	1981	Archaeological Investigations and Cultural Resource Evaluations in the Thompson Creek Locality	F. Hauck, AERC	2,400+
NA	1982	Archaeological Survey for the Cyprus Water Pipeline Project	Mary Rossilon	260+
ID4C89027	1989	Buckskin/Twin Apex Reforestation Project	Nancy Anderson	20
CH-91-0297	1991	Sheelite Jim Mine Acid Waste Cleanup	Marion McDaniel	6
CH-94-0366	1994	Thompson Creek Mine Borrow Source	Marion McDaniel	4
ID4C94042	1994	Rock Crusher Timber Sale	Linda Clark	90
ID4C97009	1997	Thompson Creek Road Maintenance	Linda Clark	1
ID4C02012	2002	Cypress Post and Pole Sale	Carol Hearne	10
CH-02-0616	2002	Cyprus-Thompson Land Sale	Dan Tyree	Unknown
ID4C04031	2004	Thompson Creek Mining Co. Pipeline ROW	Carol Hearne	10+
ID4C06006	2006	Proposed Ross Williams Land Sale	Bill Harding	350
CH-07-0716	2007	Pat Hughes Creek Repository Testing	John Rose	7
ID4C08036	2008	Golder and Associates	Thomas Hoffert	45
CH-08-0758	2008	Thompson Creek Power Line Project	Claudia Taylor Walsworth	5
CH-08-0760	2008	Bruno Creek Impoundment	Claudia Taylor Walsworth	22
CH-09-0766	2009	Road 322 Exploratory Drilling	John Rose	2
ID4C08031	2009	Thompson Creek Land Exchange Project	Rusty Smith	274
CH-11-00820	2010	Thompson Creek Mine Rock and Soil Borrow Areas	Linda Goetz and Doug Tingwall	48

Table 3.15-2. Cultural resource sites, MMPO and selected land areas

Site Number	Site Type	Site Evaluation	In MMPO Area/ Selected Land	In Permitted Mine Area[1]
10CR324	Lithic scatter	Not Eligible	X	
10CR325[2]	Open camp	Eligible		
10CR326	Historic cabin	Not Eligible		X
10CR327	Lithic scatter	Not Eligible		X
10CR328	Lithic scatter	Not Eligible	X	
10CR329	Lithic scatter	Not Eligible	X	
10CR330	Historic mine cabin remains	Not Eligible		X
10CR735	Lithic scatter/ rock pile/rock alignment	Not Eligible		X
10CR736	Quarry/lithic scatter	Not Eligible		X
10CR737	Lithic scatter	Not Eligible		X
10CR738	Lithic scatter	Not Eligible		X
10CR739	Rock shelter/ lithic scatter	Not Eligible		X
10CR740	Lithic scatter	Not Eligible	X	X
10CR741	Lithic scatter	Not Eligible	X	
10CR744	Lithic scatter	Not Eligible		X
10CR747	Lithic scatter	Not Eligible	X	
10CR748	Lithic scatter	Not Eligible	X	
10CR749	Lithic scatter	Not Eligible	X	
10CR750	Lithic scatter	Not Eligible	X	
10CR751[3]	Twin Apex Mine	Eligible		
10CR758	Cinnabar/Bruno Creek Mine/ lithic scatter	Eligible	X	
10CR1992	Quarry/ stacked rock/ lithic scatter	Not Eligible		X
10CR1993	Lithic scatter	Not Eligible	X	
37-17116	Sawmill	Not Eligible	X	

[1] The mine site includes some area permitted for mining that would not be used under any of the MMPO alternatives (Section 2.2.1).

[2] This site is adjacent to but just outside the selected land.

[3] This site is located on a privately owned in-holding that Thompson Creek Mine has no intention of purchasing.

3.15.2. Offered Lands – Broken Wing Ranch

Forty-three cultural resource inventories have been conducted in the analysis area (Table 3.15-3). A project-specific cultural resource inventory was not conducted on the entirety of the Broken Wing Ranch parcels. However, a historic structure inventory was conducted on the homestead properties on the ranch to evaluate the historic structures and associated homestead sites for potential eligibility for the NRHP (Goetz et al. 2011).

Table 3.15-3. Previous cultural resource inventories, Broken Wing Ranch analysis area.

Project Number	Year	Project Name	Author	Inventoried (acres)
NA	1977	Archaeological Inventory of the Challis Planning Unit, BLM.	Epperson, Terrence	0
NA	1982	Cultural Resource Reports for 1982.	Vaughan, Nancy	0
NA	1983	Annual Report of Archeological Investigations. IDT Boise.	Gaston, Jenna	0
NA	1984	Annual Report of Archaeological Investigations. IDT Boise.	Gaston, Jenna	0
F-FR-6393(3)	1986	ARR, Cu-75s, SU-75 Jct. US-93 to E. Fork Salmon River.	Gaston, Jenna	2
F-FR-6393(3)	1986	ARR, S.H. 75 – US 93 Junction, Salmon River Bridges.	Gaston, Jenna	425
ID4C88027	1988	CRRN, Mining Notice - Leonard Owens, SMN-040-08-02.	Anderson, Nancy	2
ID4C88015	1988	CRRN, Sink Creek Community Pit.	Anderson, Nancy	5
ID4C92036	1992	Challis Area Fish Screens. BLM, Salmon District.	Wright, Steven	1
NA	1991	Archaeological Investigations Along SH-75, Custer County, Idaho.	Petersen, Nick and Jenna Gaston	0
ID4C92009	1992	Broken Wing Telephone Cable Burial.	Wright, Steven	2 1[1]
ID4C92010	1992	East Fork Dump Site.	Wright, Steven	4 3[1]
ID4C93022	1993	Cramer Haystack Storage LUP/ Agricultural Trespass.	McLaughlin, Jim	1
ID4C93042	1993	Alkali Drift Fence.	McLaughlin, Jim	1
ID4C93049	1993	River Terrace Drift Fence and Water Trough.	McLaughlin, Jim	2
ID4C94031	1994	Alkali Spring Habitat Improvement Project.	Clark, Linda	32
ID4C93043	1993	Split Hoof Highway Fence.	McLaughlin, Jim	11
ID4C96021	1996	Three Rivers Quarry Road.	Hill, Larry	18
ID4C96040	1996	Herrick Point of Diversion and Irrigation Pipeline ROW.	Clark, Linda	4
ID4C96052	1996	Idaho Department of Transportation Material Site ROW.	Clark, Linda	1
ID4C96053	1996	Crystal Townsite Interpretive Wayside.	Clark, Linda	9
ID4C98020	1998	East Fork Road Maintenance.	Clark, Linda	2
ID4C97004	1997	Bradshaw Basin Retention Dam Maintenance.	Clark, Linda	15
ID4C99039	1999	Salmon River Fish Screen.	Clark, Linda	7

Project Number	Year	Project Name	Author	Inventoried (acres)
NA	2000	A Cultural Resource Survey of the Proposed Telecommunications Fiber Optic and Copper Cable Route, East Fork Salmon River Area, Custer County, Idaho.	Walsworth, Claudia	Unknown
ID4C00044	2000	Herrick Land Use Permit.	Clark, Linda	12
IDI-16925	2000	East Fork Salmon River Area Fiber Optic and Copper Cable Route.	Walsworth, Claudia	18
NA	2001	Proposed Digital Line Carrier Sites Associated with Challis to Stanley Telecomm Line.	Taylor Walsworth, Claudia	13
NA	2002	Proposed Challis to Stanley Telecomm Project Phase I.	Taylor Walsworth, Claudia	166
ID4C0210	2002	L&W Stone Interim Clearance for Pit 1 Waste Rock Disposal.	Hearne, Carol	3
ID4C0313	2003	East Fork Campsite Toilet and Waterline Replacement.	Hearne, Carol	2
ID4C0314	2003	JB Stone Quarry Development (Application for Extension).	Hearne, Carol	10
ID4C0323	2003	L&W Stone Corporation Rock Storage Project.	Hearne, Carol	7
NA	2004	Upper Salmon River Anadromous Fish Passage Project-Sink Creek River Diversion Site Improvement.	Walsworth, Claudia	1
ID4C04-43	2004	L&W Stone Corp. Interim Gate Authorization.	Hearne, Carol	1
BR-6390(105)	2005	SH-75 East Fork Salmon River Bridge.	Leary, S.	60
ID4C04-03	2005	L&W Stone Corp. Amended Plan of Operations.	Hearne, Carol	180
ID4C06018	2007	Salmon River Osprey Platform.	Hearne, Carol	12
BR-6390(105)	2007	Results of Archaeological Excavations East Fork Salmon River Bridge Sites Data Recovery (10CR413 and 10CR1860) and Testing (10CR113 and 10CR1862).	Leary, S., Nelson, I., Olson, D., Mitchell, K.	5
NA	2007	D6 2007 Maintenance Scaling.	Munch, M.	9 72[1]
BRF-6398(105)	2007	East Fork Salmon River Bridge.	Munch, M.	2
ID4C07028	2007	L&W Stone EIS - Amended Plan of Operations.	Hearne, Carol	60
CH-11-00814	2011	Broken Wing Ranch Survey	Goetz, L., D. Tingwall, and T. Rust	36[1]

[1] acres of reconnaissance level survey, as opposed to intensive level survey

General Land Office (GLO) maps and land patent entries for T. 12 N., R. 18 E. and T. 11 N., R 18 E., B.M. indicate historic activities in the analysis area as early as 1911. Historic structures exist on the ranch and have been documented under the historic structure inventory (CH-11-00814; Goetz et al. 2011). This study resulted in the recording of three historic homestead sites (CH-1519, CH-1520, CH-1521; Table 3.15-4). In addition, SHPO records indicate nine additional cultural sites in the ranch comprising three lithic scatters, one talus pit site, one historic cribbing across Sink Creek, a historic highway route, one historic debris scatter, one historic rock foundation, and a historic bridge. These recorded sites indicate prehistoric and historic use of the analysis area. Of the twelve sites on the ranch, seven are NRHP-eligible or unevaluated (Table 3.15-4); the associated parcel is presented in the last column of the table.

Table 3.15-4. Cultural resource sites, Broken Wing Ranch.

Site Number	Site Type	Site Evaluation	Broken Wing Ranch Parcel
10CR987	Lithic scatter	Not Eligible	N/A
10CR988	Lithic scatter	Eligible	BWR-5
10CR989	Historic debris scatter	Not Eligible	N/A
10CR990	Talus pits	Unevaluated	BWR-5
10CR998	Lithic scatter	Not Eligible	N/A
10CR1589	Rock foundation	Not Eligible	N/A
10CR1862	SH 75	Not Eligible	N/A
37-4918	Broken Wing Ranch bridge	Unevaluated	BWR-3
37-17040	Sink Creek cribbing	Eligible	BWR-6
CH-1519	Maraffio homestead	Eligible	BWR-4
CH-1520	Gini homestead	Eligible	BWR-3
CH-1521	Graham homestead	Eligible	BWR-1

3.15.3. Offered Lands – Garden Creek Property

SHPO records show no cultural resource inventories on the Garden Creek Property, but one cultural resource inventory (reconnaissance as opposed to intensive level) was conducted in the vicinity: Mink Creek Timber Sale, Caribou National Forest (5,410 acres, CB-87-177) (Birch 1987). The 1901 GLO map of T. 9 S., R. 35 E., B.M. does not show any historic features in the analysis area. However, land patent records note three entries for Section 15 between 1919 and 1923, including one for the property showing US title to the property was transferred to May Parkinson on June 20, 1919 (Doc. #017719, Serial #688179). SHPO records show no recorded cultural sites at the property. One unevaluated lithic scatter (10BK109), not associated with the previous inventory, occurs west of the property. A project-specific inventory was not conducted.

3.16. Transportation, Access, and Public Safety

The analysis areas for transportation, access, and public safety for the MMPO and land disposal alternatives is the area of the mine, the selected land, the offered lands, the public access routes to these areas, and the relevant areas of the land disposal provisions (Section 2.2.7.). However, roads in the MMPO area are not analyzed in detail.

3.16.1. MMPO Area and Selected Land

The primary access to the mine is from SH 75 at mile post (MP) 219.6 by crossing the TCM Access Bridge (owned by TCMC, near the mouth of S. Creek) over the Salmon River, traveling 1.0 mile north on a private road (owned by TCMC) to S. Creek Road (public road), and traveling 3.1 miles north on S. Creek Road to a remote-controlled gate at the start of Bruno Creek Road, which leads 5.0 miles west to the main (upper) mine site. TCMC currently allows the public to use the bridge and private road. However, the company has an exclusive easement (no public access) from the BLM to use Bruno Creek Road (and to use other roads to mine facilities along drainages to Thompson Creek). The company maintains the bridge, private road, S. Creek Road from the private road to Bruno Creek Road, and Bruno Creek Road.

The highway is paved, has two lanes, and is posted 65 mph in the vicinity of the mine access bridge. The bridge is one lane (20 feet wide) and posted 3 mph for trucks. The private road and the section of S. Creek Road between the private road and Bruno Creek Road are posted 45 mph and maintained to a width of approximately 40 feet, with a gravel and magnesium chloride surface. It is unknown for how long such public access would continue on the private bridge and road. However, 0.2 mile west of the mine access bridge is the S. Creek Bridge (MP 219.4) with public access over the Salmon River. The S. Creek Bridge is the start of 1.1 miles of the lower section of S. Creek Road (public access). In addition to mine access, S. Creek Road provides access to several residences, ranches, and BLM and NFS lands in the S. Creek drainage. S. Creek Road has many branches and extends for many miles up the S. Creek drainage.

TCMC has an easement from the BLM for exclusive (non-public) access on Bruno Creek Road (main mine access road, posted 35 mph), which is a gravel road with a magnesium chloride surface. Bruno Creek Road also provides exclusive (non-public) access to the Twin Apex private property (Figure 1.2-1., rectangular area south of the TSF with "Twin Apex Mine" in southeast corner) and the Cinnabar unpatented mining claims north of the TSF. TCMC allows the owners of the Twin Apex property to use the Bruno Creek Road to access their claims. Otherwise, the BLM would grant an exclusive easement to the owners to use the road to access their property. TCMC also allows the owners of the Cinnabar claims to use the Bruno Creek Road and the TSF access roads to access their claims. However, TCMC currently leases (with an option to purchase) the claims from the owners.

The primary access to the lower mine site is at MP 215.6 on SH 75 via the Thompson Creek Bridge (two lanes, non-public access) and Thompson Creek Road (non-public access with gate on lower section through private property), which leads 3.0 miles, 4.1 miles and 6.8 miles to the bases of the Cherry Creek, Pat Hughes and Buckskin drainages, respectively. TCMC has easements from the BLM for exclusive (non-public) use of the roads up these three drainages. TCMC maintains Thompson Creek Road (gravel surface, one lane) to the Buckskin drainage, and maintains locked gates at the starts of the Cherry Creek, Pat Hughes, and Buckskin roads.

Thompson Creek Road also provides access to BLM and NFS lands in the Thompson Creek drainage, and is the primary access for the Custer Lookout Tower. Thompson Creek Road extends with several branches more than 6 miles up the Thompson Creek drainage. Thompson Creek Road can be accessed by the public from SH 75 at the Slate Creek Bridge (MP 213.4) by traveling 2.6 miles east on the North Slate Creek Road (Forest Service #40040). The North Slate Creek Road has a gravel surface, is a narrow one lane, and is not maintained for winter use. A section of the road passes through property owned by TCMC, but the Forest Service has an easement from TCMC for non-exclusive (administrative and public) access on this section of the road.

Although the public does not have vehicle access on the selected land to the mine facilities (i.e., Bruno, Cherry Creek, Pat Hughes and Buckskin roads), the selected land is otherwise open to the public. The BLM is not aware of public-mine safety issues to date on the selected land. However, should there be such issues (e.g., people entering the toe area of the Pat Hughes WRSF) the BLM could issue a public closure order for portions of the selected land necessary to protect public safety under 43 CFR 8364.

From the S. Creek Bridge, SH 75 leads 25 miles northeast to US Highway (US) 93 (MP 244.3), or 30 miles west to SH 21 (MP 189.3) at Stanley. From Stanley SH 75 continues 116 miles south to Shoshone where US 93 leads 21 miles south to Interstate 84. From the junction of US 93 and SH 75, US 93 leads 2.2 miles north to Challis (MP 246.6), and a further 58 miles north to Salmon (MP 304.7). The average annual daily traffic on SH 75 (MP 227.0, Station #82) at the junction of East Fork Road 4 miles east of Clayton is 700 vehicles. The least traffic occurs during December through February, and the greatest traffic occurs during July and August.

The mine road network (133 miles in length) provides access to and throughout the mine. There are 34.4 miles of private roads, 57.6 miles of road on BLM land, and 41.0 miles of NFS roads in the currently permitted mine area. The widths of these roads vary from 10 to 70 feet. Some of those roads would remain in place for the life of the mine, whereas others are relocated or removed in accordance with operational requirements, e.g., some mineral exploration roads are developed and reclaimed within 1 year.

All of the mine roads including the Bruno Creek Road are bounded by berms with heights of at least mid-axle height of the largest self-propelled mobile equipment which usually travels the roadway, i.e., approximately 5 feet high in the pit and WRSFs used by the larger haul trucks, and approximately 3 feet high elsewhere. Thompson Creek Road does not have berms, but the MSHA may require TCMC to install such berms (~ 3 feet high) in the future. TCMC maintains these roads, the lower 3.1 miles of S. Creek Road, and the 1.0 mile of private road between S. Creek Road and the mine access bridge for all-weather travel by surface smoothing and dust control during the non-freezing season, and snow plowing and spot sanding during winter. TCMC plows the lower 6.8 miles of Thompson Creek Road and performs minor summer maintenance. The Forest Service performs all other required maintenance on the road, which typically comprises removing rock fall and minor rip rapping during high flow months.

The average annual daily traffic on US 93 (MP 301.6, Station #13) 3 miles south of Salmon is 2,600 vehicles, with least traffic during December through February (~ 1,900 vehicles), and the

greatest traffic during July and August (~ 3,300 vehicles). This traffic, which includes a component of local traffic, is probably similar to that between Challis and the junction of SH 75 and US 93. The average annual daily traffic on US 93 (MP 129.1, Station #55) 31 miles southeast of Challis is 530 vehicles, with the least traffic during December through February (~ 300 vehicles), and the greatest traffic during July and August (~ 800 vehicles) (ITD 2012).

For a workforce of approximately 400 employees (maximum),[22] the TCMC commuter traffic (day and night shifts) averages approximately 105 vehicles per day, and the miscellaneous traffic averages approximately 30 vehicles per day. The miscellaneous traffic is from contractors (e.g., molybdenum concentrate transport, fuel delivery, shipping delivery), vendors, mine inspectors, tours, etc., and during a few weeks each year may average as many as 60 vehicles per day (TCMC 2011). The commuter and miscellaneous vehicles make one round trip per day, 7 days per week, 52 weeks per year, with most of the vehicles traveling between the S. Creek Bridge near Clayton and Challis. The molybdenum concentrate transport is by semi-trucks with flatbed trailers making an average of three round trips each day between the mine and Challis, at which point new drivers haul the concentrate 2,100 miles to Langeloth, Pennsylvania. Therefore, the mine-related traffic comprises approximately 70 vehicle trips per day between the TCM Access Bridge and Challis, or approximately 40 percent of the total traffic on this section of SH 75 (to its junction with US 93 near Challis).

Most of the TCMC commuter traffic occurs between 5 AM and 7 AM, and between 5 PM and 7 PM during shift changes. In addition, there is more TCMC traffic during the week (e.g., 230 commuter vehicle trips and 80 miscellaneous vehicle trips) than on weekends (e.g., 150 commuter vehicle trips and 20 miscellaneous vehicle trips). However, commuter bus service during the week from Challis to the mine resumed in April 2012 (Challis Messenger 2012). The commuter bus reduces the number of vehicle trips by as much as 140 (Doughty 2012).

S. Creek Road receives perhaps two to five (non-mine) vehicle roundtrips per day during fall, and less than one to three vehicle roundtrips during the rest of the year. The North Slate Creek Road and upper Thompson Creek Road receive perhaps one or two (non-mine) vehicle roundtrips during fall, and less than one vehicle roundtrip during spring and summer. These two roads receive perhaps two or three (non-mine) roundtrips the entire winter, e.g., mountain lion hunters on snowmobiles. No Name Road (faint two-track) branches from Thompson Creek Road at MP 5.2. No Name Road extends part way up the No Name drainage, and the road is used by probably less than two or three people each year. In general, the non-mine traffic on S. Creek Road, North Slate Creek Road, and Thompson Creek Road is recreation-focused, and concentrated on weekends.

TCMC works to prevent vehicle accidents at the mine through behavioral awareness safety training, speed controls, road design, traffic pattern analysis and adjustment, warning signs, vehicle maintenance, establishing clear employee responsibilities, monetary incentive programs, etc. (TCMC 1996). Regardless, since 1981 there have been at least two private vehicle accidents

[22] During the 1980s the workforce was 550 with a similar composition as the current traffic, and a similar amount of traffic on SH 75. Therefore, during the 1980s there was ~ 40 % more mine-related traffic, which would have comprised ~ 55 % of the SH 75 traffic between the S. Creek Bridge and the junction of SH 75 with US Highway 93 near Challis.

on the main access road (Bruno Creek Road), both of which were on the descent at the last sharp curve before the lower guard station (Doughty 2012).

Vehicle accidents (related to the mine or not) on S. Creek Road and Thompson Creek Road are rare. Many vehicle accidents on highways, particularly collisions with wildlife, are never reported. However, most serious vehicle accidents are reported and documented in an electronic database maintained by the ITD. These data show 38 accidents with human injuries (average of 3.8 per year) on SH 75 during 2002 to 2011 between the S. Creek Bridge and the junction of SH 75 with US 93 near Challis (ITD 2012).

3.16.2. Offered Lands - Broken Wing Ranch

There are multiple access points to the portion of the ranch east of the Salmon River. The ranch is bisected by SH 75 (paved, 2 lanes, posted 65 mph) between MP 229.2 and MP 231.0. Lyon Creek Bridge (MP 231.2, non-public, wood deck) provides access to the portion of the ranch west of the Salmon River. The main ranch road (non-public through ranch, dirt and gravel, 1 lane) extends from SH 75 across Lyon Creek Bridge 0.4 mile north and west to the Lyon Creek ranch house, from where Lyon Creek Road extends 1.3 miles west to the western edge of BWR-1. From near this point, Leuzinger Spring Road extends 0.7 mile south to Leuzinger Spring (Figure 2.2-3).

The portion (particularly the south end) of the ranch west of the Salmon River is also accessed from SH 75 at MP 226.7 by Poverty Flat Road (public access, gravel, 1 lane) by traveling 1.5 miles north to Broken Wing Ranch Road (public access to the ranch property line, dirt, 1 lane), and then 0.3 mile to the southeast corner of the ranch. From this point there are several roads (private, dirt and gravel, 1 lane) on the ranch, but none that can be used to access the main ranch road (private, dirt and gravel, 1 lane) to the north end of the ranch during the growing season without damaging crops. The ranch can also be accessed from Poverty Flat Road via Sink Creek Road (public access, dirt, 1 lane) to Lower Sink Creek Road (public access, gravel, 1 lane) or to the unnamed road (public access, dirt, jeep track) 0.3 mile north of Lower Sink Creek Road (Figure 2.2-3). There is also a network (~ 10 miles in length) of narrow dirt tracks throughout the ranch. Traffic on the ranch is sparse with perhaps one or two vehicle round-trips and a few OHV vehicle trips per day, except during a few days in the spring and fall when tractors plow, seed and harvest hay at the ranch.

3.16.3. Offered Lands - Garden Creek Property

From Pocatello the property is reached by traveling 12.4 miles south on South Fork Mink Creek Road (Forest Service Road #163, open May 15 to November 15), and then 3.7 miles west on Scout Mountain Top Road (Forest Service Road #009, open June 1 to November 15, 2 lanes, gravel surface), the only road to the property. Scout Mountain Top Road touches the north edge of the property adjacent to the CTNF. There are no roads on the property, which is generally visited by less than one person per year as the property is not open to the public.

3.17. Hazardous Materials and Solid Waste

The analysis area for hazardous materials and solid waste for the MMPO alternatives is the mine site. No hazardous materials or solid waste are known at the selected land (North Wind 2008) or the offered lands (North Wind 2010a, 2010b), apart from common household/farm items at the

Broken Wing Ranch such as fluorescent light bulbs and batteries and fluids (e.g., oil and antifreeze) in vehicles and equipment.

Hazardous materials herein are any substance regulated by US Consumer Product Safety Commission under the Federal Hazardous Substances Act of 1960 as amended or the EPA under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (30 CFR 47.11). The mine uses hazardous materials (e.g., fluorescent light bulbs, mercury- and sodium-vapor light bulbs, paints, batteries, certain solvents such as acetone) in compliance with all applicable laws and regulations (e.g., 30 CFR 47, 56.16003-56.16004).

Solid waste is most generally any material (solid, semi-solid, liquid, or contained gas) that is discarded. Solid waste is classified as hazardous (e.g., potential to harm people, animals or the environment such as the hazardous materials listed above) or non-hazardous (e.g., glass, wood, plastic, paper, antifreeze, used oil, certain solvents such as linseed oil). Hazardous solid waste is further classified as acute (i.e., fatal to humans or substantially contribute to a serious, irreversible illness) or non-acute. TCMC does not generate any acutely hazardous solid waste, and only small quantities of non-acutely hazardous solid waste. Consequently, TCMC is a conditionally exempt small quantity generator of hazardous solid waste (CESQG) ($\leq$ 220 pounds/month non-acutely hazardous solid waste, 40 CFR 261.5).

All of the solid waste disposal at the mine is governed by Subtitle D of the Resource Conservation and Recovery Act of 1976 as amended (RCRA), the Idaho Solid Waste Facilities Act of 1992 as amended (39 Idaho Statutes 74), and/or the IDEQ Solid Waste Management regulations (IDAPA 58.01.06). Some of the non-hazardous solid waste (e.g., paper) is disposed of at the mine in a solid waste landfill. All of the other non-hazardous solid waste (e.g., antifreeze, solvents,[23] used oil including motor oil, brake fluid, transmission fluid) is removed from the site and disposed of by private disposal/recycling companies such as and Tri-State Recycling. Similarly, all of the hazardous solid waste is removed from the site and disposed of by private disposal companies (e.g., Veolia Environmental Services) who either dispose of the waste in permitted hazardous waste facilities or facilities that beneficially use or reuse the waste.

Molybdenum disulfide (the ore mineral and main component of the concentrate produced at the mine) is also not a hazardous material. More specifically, molybdenum disulfide is an inert, essentially insoluble, dry powder with no known toxicological chronic affects (e.g., not a known or potential carcinogen), and is essentially insoluble and chemically inert under ambient conditions, particularly after heating in the mill (which makes the sulfur inert). Molybdenum disulfide is not dangerous if spilled and can be readily cleaned up by absorption by vermiculate, dry sand, earth or similar materials (Material Safety Data Sheet, IMOA 2010), or simply swept up and re-containerized.

[23] Some solvents are hazardous materials, and when used are hazardous solid waste. However, TCMC does not use any hazardous solvents.

3.17.1. Solid Waste Management

An industrial solid waste landfill (anywhere in the Buckskin WRSF) was permitted when the mine started under a conditional use permit issued by the Idaho District Seven Health Department. The landfill is now approximately 30 acres in the west central area of the WRSF, and is now classified as a Tier II non-municipal solid waste landfill (> 2,000 cubic yards and not likely to produce leachate) under the Solid Waste Management regulations (IDAPA 58.01.06) that became effective in 2003. The landfill may be utilized for only non-hazardous solid waste generated at the mine (e.g., packaging materials, air filters, office waste, etc). The solid waste is collected in dumpsters, picked up with a compactor truck, hauled to the landfill, and placed in a trench excavated in mine overburden. Mining waste tires greater than 54 inches in diameter are buried in either the Buckskin or Pat Hughes WRSFs (39 Idaho Statutes 6501). During reclamation, TCMC would use one or two solid additional Tier II non-municipal solid waste landfills for disposal of concrete, wood, piping material, etc. The landfill(s) would depend on the configuration of the WRSFs at reclamation, but the potential locations are the 7,250 foot bench of the Pat Hughes WRSF due to the proximity to the areas that would require demolition, and the 7,600 foot bench of the Buckskin WRSF (Section 2.1.1.8).

3.17.2. Spills and Releases

A SPCC Plan was developed and implemented at the mine in January of 1981. The SPCC plan was last updated in 2010 (ARCADIS 2010). The goal of the plan is to prevent spills of all kinds and, if a spill occurs, to minimize the risk of injury to employees, minimize the risk of damage to the environment, and make all reasonable efforts to prevent the spill from becoming a reportable event (e.g., ≥ 25 gallons of petroleum, any petroleum that causes a sheen on surface water, any release of hazardous material) (IDAPA 58.01.02).

There have been two reportable spills of petroleum products within the last 5 years at the mine. The first was a release of an unknown quantity of gasoline from a pump in 2007 and a release of approximately 300 gallons of diesel fuel from a haul truck. Both of these releases were reported to the IDEQ and immediately remediated (Doughty 2012).

Since the mine began commercial molybdenum production in 1983, there have been seven incidents of molybdenum concentrate spilled onto public roadways, one on SH 20 near the Idaho National Laboratory, two on a curve on US 93 near Mackay, and four on SH 75. These spills were cleaned up by the responsible trucking companies without environmental enforcement action, including one spill of almost an entire truckload of molybdenum concentrate (33,000 pounds) into the Salmon River (with no appreciable environmental effects). Due to increased safety measures, there have been no molybdenum spills since 2001 (Doughty 2010a, 2011, 2012; IDEQ 2001).

CHAPTER 4

ENVIRONMENTAL EFFECTS

CHAPTER 4 – ENVIRONMENTAL EFFECTS

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4.0. ENVIRONMENTAL EFFECTS

4.1. Introduction

This chapter describes the effects of the MMPO and land disposal alternatives to the elements of the human environment (resources). A discussion of significance of an effect is required by 40 CFR 1502.16; however, the final determination of significance is the responsibility of the authorized officers for each ROD (Section 1.6). Note that most of the effects of the MMPO alternatives would be indirect effects from the mine operations on private land (which must also be analyzed under the NEPA). The direct effects for the MMPO alternatives would be primarily those from the expansion of the WRSFs and the TSF, and the relocation of the power line, i.e., the conversion of timber and recreational land to support areas for molybdenum mining. In any event, no additional analysis would reasonably be expected to cause a decision maker to reach a different decision – the fundamental threshold of adequate NEPA analysis. The effects of the MMPO and land disposal alternatives are evaluated in 16 sections:

4.2. Geologic Resources and Geotechnical Issues
4.3. Soil Resources
4.4. Vegetation, Forest Resources, and Invasive and Non-native Plants
4.5. Range Resources
4.6. Water Resources
4.7. Wildlife Resources
4.8. Fish and Aquatic Resources
4.9. Wetlands, Floodplains, and Riparian Areas
4.10. Air Quality, Noise, and Climate Change
4.11. Visual (Aesthetic) Resources
4.12. Land Use and Recreation
4.13. Socioeconomic Factors
4.14. Tribal Treaty Rights and Interests
4.15. Cultural Resources
4.16. Transportation, Access, and Public Safety
4.17. Hazardous Materials and Solid Waste

The information in these sections is summarized from the technical reports for each of the resources (JBR 2014a through JBR 2014p). These technical reports contain the references, data, modeling results, and other information used to form the effects analysis presented in this chapter. Note that the MMPO alternatives are independent (do not depend on the outcome) of the land disposal alternatives as the mine would not operate differently if TCMC acquired the selected land, which contains the southern portion of the mine. Therefore, the effects of the MMPO alternatives are evaluated separately from the effects of the land disposal alternatives, and the effects of the land disposal alternatives do not include repetition of any of the effects of the MMPO alternatives. The effects of the RMP amendment would be the same as the effects of the land disposal action alternatives.

For several resources including air quality and noise; socioeconomic factors; and transportation, access, and public safety; the effects would not vary meaningfully among the MMPO alternatives, except for their timing and duration (Table 4.1-1).

Table 4.1-1. Timing and duration of effects.

Alt.	2009	2016	2017	2020	2025	2026	2027	2030	2035
M1	M	M	CR	LSR	LTR	LTR	LTR	LTR	LTR
M2	M	M	M	M	M	CR	CR	LSR	LTR
M3	M	M	M	M	M	CR	CR	LSR	LTR

M = mining, CR = core reclamation, LSR = late-stage reclamation, LTR = long-term reclamation.

The magnitude of the effects is described according to criteria specific to each resource (Table 4.1-2). In addition, for effects with a magnitude greater than negligible, the duration of the effects is described: less than 1 year = temporary, 1 to 10 years = short term, greater than 10 years = long term. In a few cases the duration of an effect is described as permanent. The frequency of an effect is described only when such is key to understanding the effect. The magnitude, duration, and frequency descriptions are generally not provided for the no action alternative, which represents the baseline conditions against which to compare the action alternatives. Note that the effects for Alternative L2-B are evaluated under the headings for Alternative L2 only for resources for which there could be meaningful effects, i.e., there is not a parallel set of headings (Alternative L2-A and Alternative L2-B) for each resource.

Table 4.1-2. Effects determination criteria.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Geologic Resources and Geotechnical Issues	A change to world annual production of molybdenum (550 million pounds) of < 0.1 % (< 550,000 pounds). A change to world molybdenum reserves (22 billion pounds) of < 0.1 % (< 22 million pounds).	A change to the world annual production of molybdenum of 0.1 to < 1 % (550,000 to < 5,500,000 pounds). A change to world molybdenum reserves of 0.1 to < 1 % (22 to < 220 million pounds).	A change to world annual production of molybdenum of 1 to < 5 % (5,500,000 to < 27,500,000 pounds). A change to world molybdenum reserves of 1 to < 5 % (220 million to < 1.1 billion pounds).	A change to world annual production of molybdenum of > 5 % (27,500,000 pounds). A change to world molybdenum reserves of > 5 % (> 1.1 billion pounds).
Soil Resources	The modification of soil resources would not be able to be meaningfully measured or evaluated by a trained observer.	There would be a detectable and slight change to soil characteristics (e.g., productivity, susceptibility to erosion) in < 10 % of an analysis area but the change would not increase the potential for soil loss.	The changes would include change to soil characteristics (e.g., productivity, susceptibility to erosion) in 10 to 25 % of an analysis area.	The changes would include change to soil characteristics (e.g., productivity, susceptibility to erosion) in > 25 % of an analysis area.
Vegetation, Forest Resources, and Invasive and Non-native Plants	Changes to vegetation resources would not be able to be meaningfully measured or evaluated by a trained observer.	Changes would be limited to small areas, e.g., < 10 % of the resource in the analysis area. The severity and timing of changes would be expected to be within natural variability and not expected to cause long-term changes to plant communities. Key ecosystem processes may	Changes would be readily apparent and/or would affect 10 to 25 % of vegetation cover in the analysis area. The severity and timing of changes would be expected to be outside the natural variability for short periods and changes within natural variability may be long term. Key	Changes would affect > 25 % of vegetation cover in the analysis area. The severity and timing of changes would be expected to be outside natural variability for short to long periods. Changes within natural variability may be long term. In extreme cases, species might be

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
		have short-term disruptions within natural variability, but habitat for all species would remain functional.	ecosystem processes may have short-term disruptions outside natural variability, but habitat for all species would remain functional.	extirpated from the analysis area and key ecosystem processes might be disrupted, or habitat for species rendered not functional.
Range Resources	No meaningful changes to range resources, including range access.	Changes would be slight, but detectable by standard measurement. The severity and timing of changes would not be expected to be outside natural variability and would not be expected to require adjustments to season of use, distribution of livestock, or livestock numbers. There would be a change of no more than 10 % in the available AUMs in an allotment.	Changes would be apparent and the severity and timing of changes would be expected to be outside natural variability. However, the changes would be mitigated by minor adjustments to the season of use or distribution of livestock. There would be a change of no more than 25 % in the available AUMs in an allotment.	Changes would be distinct and the severity and timing of changes would be expected to be outside natural variability. The changes would not be able to be mitigated, or would require substantial adjustments to the season of use, distribution of livestock, or livestock numbers. The majority of an allotment or a substantial portion of the water supply used by livestock would be materially altered, including by changes in access to an allotment. There would be a change of more than 25 % of the available AUMs in an allotment.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Water Resources	There would be no detectable changes by standard measurements to local water quality and availability.	Changes to water quality would be detectable, but well below all applicable surface water and groundwater WQSs. Changes to water quantity would be limited to the permitted mine area.	Changes to water quality would potentially reach applicable WQSs and would potentially affect organisms or natural ecological processes. If affected, the effects would be at the lowest levels of standard biological or ecological evaluation. Changes to water quantity would occur outside the permitted mine area but would not affect other existing water rights.	Changes to water quality would potentially equal or exceed applicable WQSs and would be expected to affect organisms or natural ecological processes. Such effects would be expected to be readily apparent in standard biological or ecological evaluation. Changes to water quantity would meaningfully affect other existing water rights.
Wildlife Resources	Changes to habitat would not be able to be meaningfully measured or evaluated by a trained observer.	Changes to habitat or individuals of a species would be detectable, primarily at the scale of individuals in a localized area. There would be no changes to the viability of a local population or habitat capability.	Changes to habitat or individuals of a species would be readily detectable and sufficient to cause changes at the scale of a local population. The changes may be a reduction in population numbers, density, or habitat capability that might reduce the distribution of a species in an analysis area.	Changes to habitat or individuals of a species would be obvious and sufficient to affect a local population and possibly a regional population. The changes would probably be a reduction in local population numbers, density, or habitat capability to the point that the distribution of a species in an analysis area would be substantially reduced or eliminated, and the population would probably not return to a sustainable level.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Fish and Aquatic Resources	Changes to habitat or species would not be able to be meaningfully measured or evaluated by a trained observer.	Changes would be noticeable primarily at the scale of individuals, with no changes to long-term population numbers, distribution, or ecological function. Changes would not be expected to be outside natural variability and habitat for the species would remain functional.	Changes to habitat or individuals of a species would be sufficient to cause effects at the scale of a local population. There might be a reduction in habitat suitability for a species, a population decline, a reduction in the distribution of a species, and/or impairment of ecological function. However, the changes would probably not appreciably reduce the probability of the survival of the species in the analysis area.	Changes would probably reduce long-term habitat suitability for a species, lead to a decrease in population viability, and/or disrupt ecological function. The probability of the survival of a species in the analysis area would be appreciably reduced, possibly to zero.
Wetlands, Floodplains, and Riparian Areas	Changes in wetland size, function, or continuity would not be able to be meaningfully measured or evaluated by a trained observer.	Changes would be measurable or perceptible to a trained observer. Up to a 10 % change in size, function, or continuity of these resources in the analysis area would occur due to indirect effects such as changes in water quantity and quality changes. However, the overall viability of the resource would not be affected.	A 10 to 25 % change in the size, function, or continuity of these resources in an analysis area.	A change of > 25 % in size, function, and continuity of these resources in an analysis area. The change would be substantial and distinctly noticeable.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Air Quality and Noise	The change in the concentration of any criteria pollutant would be less than any Class II SIL (< ~ 5 % of an NAAQS), and would not exceed any NAAQS for any residential receptors in the analysis area. The change in sound level in an analysis area (outside the mine site) would not be perceptible to key receptors (≤ 3 dBA L_{DN}).	A change in the concentration of any criteria pollutant of 5 to < 25 % of an NAAQS, and no exceedance of any NAAQS for any residential receptors in an analysis area. A change in sound level in an analysis area (outside the mine site) that would be barely perceptible to clearly perceptible to key receptors (3 to < 6 dBA L_{DN}).	A change in the concentration of any criteria pollutant of 25 to 75 % of an NAAQS, and no exceedance of any NAAQS for any residential receptors in an analysis area. A change in sound level in an analysis area (outside the mine site) that would be clearly perceptible to receptors (≥ 6 to < 10 dBA L_{DN}).	A change in the concentration of any criteria pollutant of > 75 % of an NAAQS, and no exceedance of any NAAQS for any residential receptor in an analysis area. A change in sound level in an analysis area (outside the mine site) that would be distinctly perceptible (i.e., twice as loud or half as loud) to key receptors (≥ 10 dBA L_{DN}), e.g., a change of 15 dBA would be equivalent to the typical outdoor to indoor sound reduction.
Climate Change	The direct emissions of CO_2e for an alternative would be < 0.025 MT/year, the conservative, de minimis amount suggested by CEQ (2010).	The direct emissions of CO_2e for an alternative would be 0.025 MT/year to < 6 MT/year, equivalent at the upper range to the emissions from a medium-size, coal-fired power plant using current technology.	The direct emissions of CO_2e for an alternative would be 6 MT/year to 60 MT/year, equivalent at the upper range to the emissions of five, large, coal-fired power plants using current technology.	The direct emissions of CO_2e for an alternative would be > 60 MT/year.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Visual (Aesthetic) Resources	None of the element contrasts of the characteristic landscape from the KOPs would be visible or perceived by a trained observer. VRM class/VQOs would be met for an analysis area.	There would be perceptible changes to one or more element contrasts of the visual landscape from KOPs. Trained observers may notice low levels of contrasts, but the overall quality of the visual landscape would not substantially change. The level of contrast in the visual landscape would meet the current VRM class/VQOs established for an analysis area.	One or more of the feature contrasts could attract attention from casual observers at one or more KOPs, and would begin to become dominant in the visual landscape. The level of contrast in the visual landscape would not meet the current VRM class/VQOs established for an analysis area.	One or more feature contrasts would dominate the attention of a casual observer at one or more KOPs, and would be dominant in the visual landscape. The level of contrast in the visual landscape would not meet the current VRM class/VQOs established for an analysis area.
Land Use and Recreation	There would be no perceptible change in land uses. Changes to the quality of recreation would not be noticeable to individuals currently recreating in the area. There would be no change in the number of visitors to an analysis area.	There would be a change in land use conditions that would alter up to how 10 % of the land was used. Changes to the quality of recreation would be noticeable to some individuals currently recreating in the area, but would not substantially affect the quality of recreation in an analysis area.	There would be a change in land use conditions that would alter how 11 to 25 % of the land was used. Changes to the quality of recreation would be noticeable to most individuals currently recreating in the area, and would substantially affect the quality of some of the key recreational characteristics, e.g., prohibitions would be placed on motorized access.	There would be a change in land use conditions that would alter how > 25 % of the land was used. Changes to the quality of recreation would be noticeable to nearly all individuals currently recreating or wishing to recreate in the area, and would substantially affect the quality of many of the key recreational characteristics, e.g., prohibitions would be placed on most of the recreational activities or

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
				public access to the area. The area generally would no longer be available for recreational use, or the experience would be so diminished that the area generally would not be used for recreation.
Socioeconomic Factors	There would be no perceptible changes to any socioeconomic condition.	A change to a socioeconomic condition that would be perceptible to only a few residents, e.g., a change of < 1 % in the population or a gain/loss of < 3 jobs in Custer County. A minor change to a socioeconomic condition for only a few residents, e.g., a change in property value/income of < 3 %. The socioeconomic character of an analysis area would not change.	A change to a socioeconomic condition that would be perceptible to a few percent of the residents, e.g., a change of 1 to 10 % in the population or a gain/loss of 3 to 15 jobs in Custer County. A minor change to a socioeconomic condition for a few percent of the residents, e.g., a change in property value/income of < 3 %. There would be a slightly perceptible change to the socioeconomic character of an analysis area.	A change to a socioeconomic condition that would be perceptible to most residents, e.g., a change of > 10 % in the population or a gain/loss of > 15 jobs in Custer County. A minor change to a socioeconomic condition for many residents, or a major change to a socioeconomic condition for a few residents such as a change in property value/income of ≥ 3 %. There would be a readily apparent change to the socioeconomic character of an analysis area.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Tribal Treaty Rights and Interests	There would be no perceptible change to features that are integral in maintaining the cultural and religious identity of a Native American community. The action would not conflict with Tribal treaty rights and interests. There would be no change in the amount of unoccupied Federal land in an analysis area.	Adverse: There would be a slightly perceptible change to features that are integral in maintaining the cultural and religious identity of a Native American community that would slightly diminish the relationship between these features and the community's cultural and religious identity. There may be a limited change to traditional resource access and Tribal treaty rights. There would be a net decrease of < 1 % in the unoccupied Federal land in the analysis area. Beneficial: The action would allow/enhance traditional resource access and Tribal treaty rights. There would be a net gain of < 1 % of the unoccupied Federal land in an analysis area.	Adverse: There would be a substantial change to features that are integral in maintaining the cultural and religious identity of a Native American community that would interfere with the relationship between these features and the community, but the cultural and religious identity would be generally intact. There would be substantial interference with traditional resource access and/or Tribal treaty rights. There would be a net decrease of 1 to 5 % in the unoccupied Federal land in an analysis area. Beneficial: The action would enhance or improve traditional resource access and/or Tribal treaty rights. There would be a net gain of 1 to 5 % of the unoccupied Federal land in an analysis area.	Adverse: There would be a substantial change to features that are integral in maintaining the cultural and religious identity of a Native American community to such an extent that the cultural and religious identity could be lost. There would be substantial interference or elimination of traditional resource access and/or Tribal treaty rights. There would be a net decrease of > 5 % in the unoccupied Federal land in an analysis area. Beneficial: The action would substantially enhance or improve traditional resource access and/or Tribal treaty rights. There would be a net gain of > 5 % in the unoccupied Federal land in an analysis area.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Cultural Resources	There would be no perceptible consequences for archaeological resources, cultural landscapes, or historic structures. The Section 106 determination would be no historic properties affected.	Adverse: There would be a slight, measurable, and perceptible effect that would be permanent, but the effect would be to a limited area of a site or group of sites or few of a cultural landscape's features. The Section 106 determination would be adverse effect. Beneficial: Small areas of a site, group of sites, structures, or features of a cultural landscape would be preserved.	Adverse: There would be a measurable and perceptible effect that would be permanent. The effect would change one or more of the features or characteristics of the site, structure, or landscape that would qualify the site, structure or landscape for the National Historic Register and somewhat diminish the integrity of the site, structure or landscape. The Section 106 determination would be adverse effect. Beneficial: The action would noticeably enhance the preservation and protection of the site, structure, or landscape.	Adverse: There would be a substantially measurable and perceptible effect that would be permanent. The effect would change one or more of the features of the site, structure, or landscape and would diminish the integrity to such an extent that it would no longer be eligible for listing on the National Historic Register. The Section 106 determination would be adverse effect. Beneficial: The action would substantially enhance the preservation and protection of the site, structure, or landscape.

Resource	Negligible effect	Minor effect	Moderate effect	Major effect
Transportation, Access, and Public Safety	Changes would not be noticeable to most visitors to an analysis area. See Land Use and Recreation above for the description for Access. For public safety, there would not be proportionally more injury or illness, apart from injury or illness requiring only very basic first aid.	Changes would be apparent to some (e.g., < 25 %) visitors to an analysis area. Changes would cause somewhat shorter or longer travel times; increase or decrease in access to very limited areas; change in access type (e.g., motorized versus non-motorized) on minor access routes; etc. For public safety, there would be a change that would cause a proportional increase in injury or illness resulting in lost workday(s).	Changes would be apparent to many (e.g., > 25 %) visitors to an analysis area. Changes would cause distinctly shorter or longer travel times; decrease or increase in access to more extensive areas; change in access type (e.g., motorized versus non-motorized) on major access routes; somewhat alter the character of an analysis area; etc. For public safety, there would be a change that would cause a proportional increase in injury or illness involving permanent partial disability or temporary total disability.	Changes would be apparent to most people visiting an analysis area. Changes would distinctly alter the character of an analysis area, e.g., year-round closure of a major access route such as the S.[1] Creek Road, or increase or decrease of access to 1,000s acres. For public safety, there would be a change that would cause death or permanent total disability.

[1] *Squaw Creek* is an official place name in Custer County, and appears in numerous published documents including US Geological Survey topographic maps. The name was established by the US Board of Geographic Names to maintain uniform geographic name usage throughout the Federal Government. However, the word *squaw* is offensive to some people including the Shoshone-Bannock Tribes. Therefore, *Squaw Creek* is hereafter referred to in the main text as *S. Creek*.

4.2. Geologic Resources and Geotechnical Issues

4.2.1. MMPO Alternatives

4.2.1.1. Alternative M1 – No Action Alternative

The open pit would continue to provide comprehensive exposure (~ ½ mile vertical height) of metasedimentary, granitic, and volcanic rocks, as well as geologic structures such as faults and fractures. The Federal land at the mine (most of the mine is on private land not subject to mining claims) would continue to be covered by mining claims owned by TCMC. The company would continue to explore some of the claims for molybdenum. There would be a very low probability in the foreseeable future of leasable mineral development on Federal lands at the mine, and there would be no salable mineral development on Federal lands at the mine. The mine would produce approximately 15 to 20 million pounds of molybdenum per year or 73 million pounds of molybdenum by March 2016. The mine would also produce 174 million tons of waste rock and generate tailings. No additional production of molybdenum would occur after 2016.

Extensive and detailed site-specific geotechnical analyses demonstrate stability under both static and dynamic conditions (i.e., seismic shaking) for the pit walls, the WRSFs, and the TSF (CNI 2011; Golder 2007, 2010; KP 2011a, 2011b, 2013; URS 2000; VTN 1980b). The facilities would be stable during even the maximum credible earthquake during both mining and post-reclamation. The maximum credible earthquake would cause only small-scale (e.g., bench-scale or less) rock fall from the surfaces of the pit walls. There could be slight settling slumps (e.g., 12 inches) in the tops of the WRSFs and rocks rolling from surfaces of the faces of the facilities, but there would not be collapse of buildings, breach of fuel tanks (which would drain to containment basins), fault scarps (no major active faults at the mine site), or major collapse of a facility (including the TSF) at the mine. Over hundreds of years the pit walls would gradually slough and ravel to cover the faces and floors of the benches producing relatively smooth pit wall slopes.

There are no known paleontological resources and low potential for meaningful paleontological resources in the analysis area, apart from the Bruno Creek fossil outcrop. However, the Bruno Creek outcrop would continue to be unaffected by mining and would not be accessible to the public during the mine life due to the exclusive easement held by TCMC for Bruno Creek Road. The outcrop would be more accessible to paleontological collection by the public (i.e., reasonable amounts of common invertebrate and plant paleontological resources as allowed by 16 USC 470aaa(1) and 43 CFR 8365.1-5) after reclamation if the public were allowed to use the Bruno Creek Road during late-stage reclamation.

4.2.1.2. Alternative M2 – MMPO as Submitted by TCMC

The open pit would expose an additional 250 vertical feet of granitic rock in the base of the pit (negligible effect to geologic resources/physiography). The mine would produce 10 to 20 million pounds of molybdenum per year, or an additional 131 million pounds of molybdenum during 9 years (short-term, moderate effect to world molybdenum production and short-term, minor effect to world molybdenum reserves). The mine would also produce an additional 96 million tons of waste rock. The key mine facilities would be stable under both static and

dynamic conditions (CNI 2011; Golder 2007, 2010; KP 2011a, 2011b; KP 2013; URS 2000; VTN 1980b) (no effect).

There would be no meaningful effects to paleontological resources, i.e., no effect to the Bruno Creek fossil outcrop and low potential for the discovery of meaningful paleontological resources in the analysis area (negligible effect).

4.2.1.3. Alternative M3 – No Name Waste Rock Storage Facility

The mine would have the same effects to world molybdenum production and reserves and produce the same amount of waste rock as for Alternative M2. However, the No Name WRSF would contain approximately 115 million tons, and the Pat Hughes and Buckskin WRSFs would contain that much less waste rock. The No Name WRSF would be developed using the same fundamental design as that of the Pat Hughes and Buckskin WRSFs; therefore, the geotechnical issues (i.e., stability) of the No Name WRSF would be the same as those under Alternative M1 and Alternative M2.

The effects to paleontological resources would be the same as under Alternative M1.

4.2.2. Land Disposal Alternatives

4.2.2.1. Alternative L1 – No Action

The selected land would continue to be covered by mining claims owned by TCMC, and has not been available for locatable mineral entry under Federal mining laws by anyone other than the owner of the mine since the late 1960s to early 1970s. In addition, the BLM has no records of any disposals of salable minerals from the selected land. The probability of meaningful mineral development (locatable, leasable, or salable) of the selected land in the foreseeable future, apart from that for support operations for the mine, would be very low. The minerals on the offered lands would continue to be owned by the land owner (currently TCMC), and would be unavailable to mineral entry under Federal mining laws. Small quantities (e.g., < 50 tons/year) of quartzite talus may be sold from the Broken Wing Ranch during some years for use as decorative rock and building stone. However, there would be little probability that meaningful mineral development would occur at either the ranch or the Garden Creek property.

There would be no change in the jurisdiction of paleontological resources.

4.2.2.2. Alternative L2 – Land Exchange Proposal

The selected land would become private land no longer available under Federal laws and regulations for mineral entry for locatable or leasable minerals, or for disposal of salable minerals. However, the selected land has not been available for locatable mineral entry by anyone other than the owner of the mine since the late 1960s and early 1970s. Also, there would be a very low probability in the foreseeable future of leasable or salable mineral development on the selected land (minerals used in support of the mine such as colluvium for reclamation would be acquired under the Federal mining laws and not sold by the BLM as a salable mineral).

The US would acquire the mineral estates of the offered lands by donation from TCMC, and the offered lands would not be subject to the land and mineral laws unless the BLM issued a public land order to that effect (43 CFR 2091.8). The BLM does not presently intend to issue such order. Therefore, the offered lands would not be open to locatable, leasable, or salable mineral operations in the foreseeable future. Regardless, the BLM would probably not dispose of quartzite or other salable minerals such as sand and gravel from the ranch, since similar materials are available from nearby sites on other BLM land and are widely available in the region from existing quarries and gravel pits. Similarly, even if the Garden Creek property were available for disposal of salable minerals, the BLM would probably not dispose of such minerals from the property because of its isolated location. The probability of a valuable locatable or leasable mineral deposit occurring at the offered lands would be very low. All of these effects would be negligible. However, the geologic resources of the Broken Wing Ranch and the upper Lyon Creek drainage would be readily available for rockhounding, field inspection, or study by the public (e.g., the Boise State University geology department) (long-term, minor effect).

The Bruno Creek fossil outcrop, as private property, would not be available for paleontological collection by the public and would be protected by a conservation easement along the portion of S. Creek on the selected land. However, under Alternative L2 the outcrop would not be available to the public during the foreseeable future due to the exclusive easement held by TCMC for the Bruno Creek Road (negligible effect).

4.2.2.3. Alternative L3 – Land Sale

The effects would be the same as for Alternative L2 regarding the selected land, and the same as for Alternative L1 regarding the offered lands, except the geologic resources of the Broken Wing Ranch would not be available (and those of the upper Lyon Creek drainage would not be readily available) for rockhounding, field inspection, or study by the public (long-term, minor effect). In addition, if the selected land was sold to a party other than TCMC, the mineral rights for the property and the right to extract the minerals would be reserved to the US for continued use by TCMC (long-term, major effects).

Due to the lack of known paleontological resources or rocks with high potential for meaningful paleontological resources at the offered lands, the effect to paleontological resources would be the same as for Alternative L2 (negligible effect).

4.2.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

Compared to Alternative L2 and Alternative L3, approximately 1,500 acres of the selected land would remain open to mineral entry and disposal of salable minerals. However, locatable mineral entry in the foreseeable future by anyone other than TCMC would be precluded by the existing mining claims on the 1,500 acres. Compared to Alternative L2, approximately 30 percent less (by fair market value) offered lands would be acquired by the US and would become open to mineral entry and disposal of salable minerals (negligible effects).

The effects to paleontological resources would be the same as for Alternative L2 (negligible effect), i.e., the effects would not vary with the amount of selected land that would become privately owned or the amount of offered lands acquired by the US.

4.2.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects regarding the selected land would be the same as for Alternative L2, except there would be no probability of locatable, leasable, or salable mineral development on the approximately 1,500 acres covered by the conservation easement. The effects regarding the offered lands would be the same as for Alternative L4, except more (by fair market value) of the offered lands would be acquired by the US and would become open to mineral entry and disposal of salable minerals (e.g., only ~ 10 % less by fair market value compared to Alternative L2) (negligible effects).

The effects to paleontological resources would be the same as for Alternative L4.

4.3. Soil Resources

4.3.1. MMPO Alternatives

4.3.1.1. Alternative M1 – No Action

The erosion (wind and water), compaction, and loss of soil would continue at the mine as it has for the last 30 years. Most of the lifetime soil loss at the mine was during soil removal and storage for the initial mine development during 1981 to 1983. Most of the current soil loss is from the Bruno Creek access road and general fugitive dust (Section 4.10.1.1). TCMC has not had to remove sediment from the two Bruno Creek sedimentation ponds since the sediment windows (traps) were installed along Bruno Creek Road in 1988 (Doughty 2013). The sediment traps are typically cleaned twice each year for an annual sediment loss from the road of approximately 80 cubic yards (~ 40 traps, ~ 1 cubic yard/clean out). The sediment (high-quality soil) is stockpiled at various soil salvage piles, protected from erosion (e.g., Photo 2.1-18.), and used in mine reclamation (Natoli 2013).

4.3.1.2. Alternative M2 – MMPO as Submitted by TCMC

By the end of active mining, the expansion of the WRSFs and the TSF would cause 336.0 acres of soil to be removed (or inundated in the case of the TSF). Soil on an additional 112.1 acres associated with the pipeline, power line, and operational areas would be compacted and/or removed and replaced by construction activities (Table 4.3-1). The final reclamation grading of the TSF would affect an additional 48.9 acres of soil. The compaction of soil would disrupt soil textures and reduce soil productivity. The removal (± storage) and replacement of soil would destroy soil textures and cause soil loss due to wind and water erosion, with a resulting loss of nutrients, organic matter, and microbial communities in the soil. Therefore, the soil replaced during reclamation (all areas except the open pit) would have decreased soil productivity and increased susceptibility to erosion, particularly on steeper slopes and/or relatively erodible soil (short-term, moderate to major effects) (Table 4.3-1., Table 4.3-2). These effects would be mitigated during reclamation by erosion controls and revegetation (negligible to moderate effects, depending primarily on slope, soil erodibility, and amount of revegetation) (Table 4.3-3). Soil erosion would increase sediment delivery to surface water (Section 4.6).

Table 4.3-1. Soil erodibility, Alternative M2.

Disturbance Area	Soil Erodibility		TOTAL
	High	Moderate	
Buckskin WRSF[1]	0	63.8	63.8
Pat Hughes WRSF[1]	0	189.9	189.9
TSF[1]	0	131.2	131.2
Subtotal	**0**	**384.9**	**384.9**
Operational Area	4.4	66.0	70.4
Pipeline	0	19.7	19.7
Pit	0	0	0
Power Line	8.0	14.0	22.0
Subtotal	**12.4**	**99.7**	**112.1**
TOTAL	**12.4**	**484.6**	**497.0**

[1] Soil erodibility determined using data and characteristics for borrow soil assumed to be used for cover soil.

Table 4.3-2. Soil effects during mining, Alternative M2.

Duration	Disturbance Area	Effects		TOTAL
		Major	Moderate	
Long term	Buckskin WRSF[1]	31.9	31.9	63.8
	Pat Hughes WRSF[1]	95.0	95.0	189.9
	TSF[1]	28.8	53.5	82.3
	Subtotal	**155.7**	**180.4**	**336.0**
Temporary	Operational Area	55.3	15.1	70.4
	Pipeline	17.7	2.0	19.7
	Pit	0	0	0
	Power Line	20.4	1.6	22.0
	Subtotal	**93.4**	**18.7**	**112.1**
	TOTAL	**249.1**	**199.1**	**448.1**

[1] Effects determined using data and characteristics for borrow soil assumed to be used for cover soil; final grade slopes for WRSF footprint assumed to be 50 % at > 30 % slope and 50 % between 8 and 15 %; post-mining grade slopes for TSF footprint presumed to be 35 % at > 30 % slope and 65 % at < 5 % slope.

Table 4.3-3. Post-reclamation effects to soil, Alternative M2.

Duration	Disturbance Area	Effects			TOTAL
		Moderate	Minor	Negligible	
Long term	Buckskin WRSF[1]	31.9	31.9	0.0	63.8
	Pat Hughes WRSF[1]	95.0	95.0	0.0	189.9
	TSF[1]	45.9	0.0	85.3	131.2
	Subtotal	**172.8**	**126.9**	**85.3**	**384.9**
Temporary	Operational Area	38.4	25.0	7.0	70.4
	Pipeline	15.0	3.6	1.1	19.7
	Pit	0	0	0	0
	Power Line	15.6	4.8	1.6	22.0
	Subtotal	**69.0**	**33.4**	**9.7**	**112.1**
	TOTAL	**241.8**	**160.3**	**95.0**	**497**

[1] Effects determined using data and characteristics for presumed borrow soil to be used for cover soil; final grade slopes for WRSF footprint assumed to be 50 % at > 30 % slope and 50 % between 8 and 15 % slope; final grade slopes for TSF footprint assumed to be 35 % at > 30 % slope and 65 % at < 5 % slope.

4.3.1.3. Alternative M3 – No Name Waste Rock Storage Facility

By the end of active mining, the expansion of the WRSFs and the TSF would cause 477.6 acres of soil to be removed (or inundated in the case of the TSF), 141.6 acres more than under Alternative M2. Soil would be salvaged from the Pat Hughes WRSF (8.5 acres) and the No Name WRSF (4.0 acres) as part of the construction of the underdrains for these facilities. However, there would be less soil removed from the Pat Hughes and Buckskin WRSFs due to their smaller size (Table 4.3-4., Table 4.3-5., Table 4.3-6).

Table 4.3-4. Soil erodibility, Alternative M3.

Disturbance Area	Soil Erodibility		TOTAL
	High	Moderate	
Buckskin WRSF	0	0	0
No Name WRSF[1]	0	233.5	233.5
Pat Hughes WRSF[1]	0	161.8	161.8
TSF[1]	0	131.2	131.2
Subtotal	**0**	**526.5**	**526.5**
Operational Area	4.4	66.0	70.4
Pipeline	0	19.7	19.7
Pit	0	0	0
Power Line	8.0	14.0	22.0
Subtotal	**12.4**	**99.7**	**112.1**
TOTAL	**12.4**	**626.2**	**638.6**

[1] Soil erodibility determined using data and characteristics for presumed borrow soil to be used for cover soil.

Table 4.3-5. Soil effects during mining, Alternative M3.

Duration	Disturbance Area	Effects		TOTAL
		Major	Moderate	
Long term	Buckskin WRSF	0	0	0
	No Name WRSF[1]	116.8	116.8	233.5
	Pat Hughes WRSF[1]	80.9	80.9	161.8
	TSF[1]	28.8	53.5	82.3
	Subtotal	**226.5**	**251.2**	**477.6**
Temporary	Operational Area	55.3	15.1	70.4
	Pipeline	17.7	2.0	19.7
	Pit	0	0	0
	Power Line	20.4	1.6	22.0
	Subtotal	**93.4**	**18.7**	**112.1**
	TOTAL	**319.9**	**269.9**	**589.7**

[1] Effects determined using data and characteristics for presumed borrow soil to be used for cover soil; final grade slopes for WRSF footprint assumed to be 50 % at > 30 % slope and 50 % between 8 and 15 % slope; post-mining grade slopes for TSF footprint assumed to be 35 % at > 30 % slope and 65 % at < 5 % slope.

Table 4.3-6. Post-reclamation effects to soil, Alternative M3.

Duration	Disturbance Area	Effects			TOTAL
		Moderate	Minor	Negligible	
Long term	Buckskin WRSF	0	0	0	0
	No Name WRSF[1]	116.8	116.8	0.0	233.6
	Pat Hughes WRSF[1]	80.9	80.9	0.0	161.8
	TSF[1]	45.9	0.0	85.3	131.2
	Subtotal	**243.6**	**197.7**	**85.3**	**526.6**
Temporary	Operational Area	38.4	25.0	7.0	70.4
	Pipeline	15.0	3.6	1.1	19.7
	Pit	0	0	0.0	0
	Power Line	15.6	4.8	1.6	22.0
	Subtotal	**69.0**	**33.4**	**9.7**	**112.1**
	TOTAL	**312.6**	**231.1**	**95.0**	**638.7**

[1] Effects determined using data and characteristics for borrow soil assumed to be used for cover soil; final grade slopes for WRSF footprint assumed to be 50 % at > 30 % slope and 50 % between 8 and 15 % slope; final grade slopes for TSF footprint assumed to be 35 % at > 30 % slope and 65 % at < 5 % slope.

4.3.2. Land Disposal Alternatives

4.3.2.1. Alternative L1 – No Action

It is unknown how the Broken Wing Ranch and Garden Creek property would be managed in the foreseeable future. However, in the short term the ranch would probably be managed to produce hay and for cattle grazing with a reasonable probability of limited residential development (e.g., a few houses) along the Salmon River, and the Garden Creek property would probably remain undeveloped or have limited residential development. The benefits to riparian soil from the BLM ranch management strategies would not occur (exclusion of cattle, increased riparian vegetation, resting BWR-7 from grazing, etc.).

4.3.2.2. Alternative L2 – Land Exchange Proposal

There would be no effects to soil on the selected land, except for the portion of the land that would be affected by the MMPO alternatives (Section 4.3.1). The improvements at the ranch (e.g., widening roads, kiosks, campground) would result in small areas of soil compaction and increased soil erosion, especially in areas where vehicles would be present (parking areas, campground). The riparian areas would continue to be fenced to exclude cattle, which would reduce soil compaction in these areas if cattle were on the ground when it was wet, and would (along with the development of more riparian vegetation, particularly along lower Lyon Creek per the Lyon Creek conceptual restoration plan) reduce soil erosion/loss (long-term, negligible to minor effects).

Under L2-B approximately half (52 %) of the soil at the ranch would be fundamentally altered by the conversion to native vegetation, e.g., increased organic matter/microbial biomass/carbon sequestration; reduced bulk density (no equipment compaction); development of biological crusts; etc. (long-term, major effect). Soil erosion/loss would be comparable to that of the cultivated fields (Section 3.3.2.), except perhaps an increase by 1 order of magnitude before native vegetation was well established (negligible effect). An increase in public use at the Garden Creek property could cause slight soil compaction and erosion in a few places used for hiking, berry picking, camping, etc. (negligible effect).

4.3.2.3. Alternative L3 – Land Sale

The effects to the selected land would be the same as under Alternative L2. The effects to the offered lands under Alternative L2 would not occur; therefore, the effects to the offered land would be the same as under Alternative L1. There could be additional soil compaction/erosion/loss from limited residential development on the Broken Wing Ranch and Garden Creek property (short-term, negligible to minor effects).

4.3.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The effects would be the same as under Alternative L3, except some of the ranch subparcels and/or the Garden Creek property would not be acquired by the US. The soil on such lands would be subject to compaction/erosion/loss from limited residential development (short-term, negligible to minor effects).

4.3.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects would be the same as under Alternative L4.

4.4. Vegetation, Forest Resources, and Invasive and Non-native Plants

4.4.1. MMPO Alternatives

4.4.1.1. Alternative M1 – No Action

There would be no change to the existing vegetation (plant or tree) communities, patterns, or productivity/carbon sequestration during mining. The management of weeds would not change. There would not be disturbance to suitable special status plant habitat. After mining (~ 2016), soil would be replaced and revegetation would occur on all of the disturbed areas except the open pit and infrastructure required for long-term water management (e.g., certain roads, buildings, power lines, and pipelines). Reclaimed areas would initially be grassland (forbs and grasses) in primary ecological succession.[2] Over several years the vegetation would evolve to grassland and shrubland, and then shrubland and conifer (lodgepole) seedlings. In perhaps a decade the vegetation would evolve to shrubland with scattered conifer saplings. Over decades the vegetation would evolve to young and then mature conifer shrubland or conifer forest, with old growth conifer trees developing as the climax species in 120 to 150 years (USFS 1992).

[2] the growth of pioneer species on land not previously vegetated, as opposed to the growth of pioneer species on land where the vegetation has been destroyed but without severe disturbance to soil

4.4.1.2. Alternative M2 – MMPO as Submitted by TCMC

A total of 497.0 acres of primarily upland vegetation would be removed during mining, primarily conifer forests (391.0 acres) and shrubland (62.0 acres) (Table 4.4-1). However, these vegetation communities are common in Custer County and in the area around the mine, i.e., no unique vegetation communities would be affected (short-term to long-term, major effects). There would be an increased probability of noxious weeds in the disturbed areas (long-term, moderate effect). Despite substantial fugitive dust suppression, deposition of fugitive dust near roads would affect photosynthesis, respiration, transpiration, and reproductive rates of vegetation near roads (negligible effect). Sensitive species would not be removed, but the species would be indirectly affected by the removal of their suitable habitat, particularly that for whitebark pine at the highest elevations. However, such effects would be so minimal as not to cause a trend toward listing under the ESA (long-term, minor effect).

Timber (2,548 mbf) would be harvested in phases during 14 to 15 years from 391.0 acres prior to expansion of the WRSFs and the TSF, which would affect forest diversity and timber production (long-term, moderate effect). More specifically, 84 acres of Douglas-fir, Douglas-fir/lodgepole pine, and mixed subalpine fir forests would be removed at the TSF; 14 acres of Douglas-fir plant communities would be removed for new pipelines (primarily around the perimeter of the TSF); 0.67 acre of subalpine fir/elk sedge would be removed at the open pit; and 22 acres mostly subalpine fir/elk sedge would be removed for the power line relocations. Trees growing in the power line corridors would also be removed or trimmed to minimize the probability of falling trees or wildfire damaging the power lines (long-term, minor effect). Timber harvest would follow BLM and Forest Service BMPs which were designed specifically to reduce sedimentation and protect soil qualities.

Table 4.4-1. Vegetation disturbance, Alternative M2.

Jdx.[1]	Developed/ Disturbed	Barren/Rock	Douglas-fir/ Elk Sedge	Douglas-fir/ Pinegrass	Douglas-fir/ Snowberry	Douglas-fir	Douglas-fir/ Lodgepole Pine	Lodgepole Pine	Mix Subalpine	Subalpine Fir/ Elk Sedge	Mountain Big Sagebrush	Subalpine Fir/ Pinegrass	Grassland	Wyoming Big Sagebrush	Shrub Riparian	Douglas-fir/Arnica	Area (acres)
BLM	0.4	1.3		7.6	0.1	108.2	26.1	3.8	0.4		3.5	8.4	0.8	39.9	0.04		200.6
Forest Service			101.2	12.9	5.8	24.7				30.8	5.6						185.5
Private	15.8	21.2	25.0	13.5	12.1		4.7		0.02	3.7	11.4			1.6		1.9	110.9
TOTAL	**0.4**	**22.5**	**126.2**	**34.0**	**18.0**	**132.9**	**30.8**	**3.8**	**0.42**	**34.1**	**19.4**	**8.4**	**0.8**	**41.5**	**0.04**	**1.9**	**497.0**

[1] There would be no disturbance to subalpine fir/whitebark pine cover types; Jdx. = Jurisdiction.

Core reclamation would begin in 13 years whereas under Alternative M1 core reclamation would begin in 4 years. During reclamation trees would not be planted at the TSF (564 acres) (to minimize root penetration through the cap) (long-term, major effect). As described for Alternative M1, reclamation would initiate pioneer growth in primary succession which would gradually evolve to climax conifer shrubland and conifer forest. The initial revegetation would result in at least 70 percent of the ground cover found on adjacent reference areas. However, for decades (or 100 to 200 years for the conifer forests) there would be different vegetation patterns (e.g., early stage, fragmented communities) and lower vegetation productivity (long-term, moderate effects), and the area of the pit (~ 500 acres) would remain as rocky outcrop with a pit lake (long-term, moderate effects).

4.4.1.3. Alternative M3 – No Name Waste Rock Storage Facility

A total of 640.6 acres (29 % more than under Alternative M2) of primarily upland vegetation would be removed, primarily conifer forest (487.2 acres) and shrubland (105 acres) (short-term to long-term, major effect) (Table 4.4-2). There would be an increased probability of noxious weeds in the larger amount of disturbed areas, but the effect would be the same as for Alternative M2. There would be 27 percent more timber (3,169 mbf versus 2,548 mbf) harvested from a larger area (487.2 acres versus 391.0 acres) compared to under Alternative M2, but the effect would be the same as for Alternative M2.

Table 4.4-2. Vegetation disturbance, Alternative M3.

Jdx.[1]	Developed/ Disturbed	Barren/Rock	Douglas-fir/ Elk Sedge	Douglas-fir/ Pinegrass	Douglas-fir/ Snowberry	Douglas-fir	Douglas-fir/ Lodgepole Pine	Lodgepole Pine	Mix Subalpine	Subalpine Fir/ Elk Sedge	Mountain Big Sagebrush	Subalpine Fir/ Pinegrass	Grassland	Wyoming Big Sagebrush	Shrub Riparian	Douglas-fir/ Arnica	Area (acres)
BLM	0.16	18.8		7.6	0.11	189.6	78.6	21.8	2.8		18.3	8.4	1.7	70.0	0.2		418.1
Forest Service	0.01		55.8	10.6	5.8	24.7			0.4	23.3	5.6		4.5				130.7
Private	15.8	4.5	20.3	11.5	12.0	4.1	4.7		0.02	2.9	11.2	0.2	1.0	1.6		1.9	91.8
TOTAL	**0.16**	**23.3**	**76.1**	**29.7**	**17.9**	**218.4**	**83.3**	**21.8**	**3.2**	**26.2**	**35.1**	**8.6**	**7.2**	**71.6**	**0.2**	**1.9**	**640.6**

[1] There would be no disturbance to subalpine fir/whitebark pine cover types; Jdx. = Jurisdiction.

4.4.2. Land Disposal Alternatives

4.4.2.1. Alternative L1 – No Action

The condition of a narrow riparian corridor with sections of incised and trampled streambanks at the ranch would be improved due to recent riparian fencing, but further protection of the riparian area by better grazing strategies (BLM ranch management strategy) would not occur. Subparcel BWR-7 would not be rested from grazing (less residual vegetation). Compared to the surrounding Federal lands, there would probably be a similar probability of wildfire at the ranch, e.g., a higher probability of wildfire due to ranching activities, but a lower probability due to the irrigated land. The probability of developing noxious weeds at the Garden Creek property would be the same as for the surrounding Federal lands.

4.4.2.2. Alternative L2 – Proposed Land Exchange

There would be no effects to vegetation, forest resources, or invasive and non-native plants ("weeds") on the selected land (e.g., there is no sensitive plant species habitat at the selected land) except for the portion that includes the MMPO (Section 4.4.1). Approximately 2,500 feet of the S. Creek riparian corridor would leave Federal jurisdiction (Figure 2.2-1). A conservation easement would prohibit subdivision/residential development of the corridor. There would also be no effects to vegetation, forest resources, or weeds within the Thompson Creek corridor.

There would be a long-term increase in riparian vegetation at the ranch as the BLM ranch management strategies include restoration or protection of the shrub and forest corridor along Lyon Creek and the Salmon River. In particular, the lower 1,850 feet of Lyon Creek would have decreased sloughing and increased riparian vegetation per the Lyon Creek conceptual restoration plan (long-term, moderate effect). Approximately half of the ranch is considered potentially occupied by special status plants (i.e., the portion that is not cultivated agriculture) (Lemhi milkvetch and white eatonella occur at the ranch); this portion would receive extra protection for special status plant species and their habitat; i.e., under BLM jurisdiction management of special status plants would comply with BLM policy on special status plants (BLM Manual 6840 and supplement 6840.06 and Handbook H-6840-1) (long-term, minor effect). Public use of roads at the ranch would increase the probability of noxious weed development at the ranch (long-term, minor effect). The vegetation on portions of BWR-4, BWR-5, and BWR-6 would be affected by improvements such as a campground, interpretive site, or other recreational facility that would increase soil compaction, vegetation trampling, and noxious weed development (long-term, minor effect).

There would be a lower probability of noxious weed development in the Lyon Creek drainage under Alternative L2 (non-motorized access to the drainage) compared to Alternative L2-B (allows motorized access up the Lyon Creek drainage) (long-term, minor effect). There would continue to be livestock transport of weed seed on the ranch under Alternative L2, compared to no such transport on the areas of the ranch converted to native vegetation (~ half of the ranch) under Alternative L2-B. However, compared to Alternative L2 (cultivated fields), the converted area of the ranch (disturbed, relatively sparse vegetation) would be prone to weed infestation under Alternative L2-B in the long term, despite the BLM weed control program (negligible to moderate effect, depending on the success of the conversion to native vegetation). Under

Alternative L2-B all of the irrigated fields (portions of BWR-2 through BWR-7, 424 acres, 52 % of the ranch) would be converted to native vegetation (sagebrush steppe), which, compared to Alternative L2, would be a decrease of 95.4 percent in the agricultural land (currently 444.5 acres), and an increase of 123.0 percent of the sagebrush steppe (currently 9.5 acres of semi-desert grassland and 335,1 acres of semi-desert shrubland) (long-term, major effect). Not grazing the native vegetation would have little effect on the vegetation (e.g., Atwood et al. 1987; Holechek and Stephenson 1983; Hughes 1983; Pieper et al. 1993), and the vegetation communities would be expected to remain in mid- to late stage ecological succession with a static to upward ecological trend (negligible effect). However, as residual herbaceous and litter cover increases there would be a greater probability of wildfire at the ranch (negligible effect).

Federal acquisition of the Garden Creek property would allow better control of noxious weeds in the locality, and better protection of sensitive plant species and their habitat, e.g., there is suitable habitat for Idaho sedge along Garden Creek (long-term, minor effects).

4.4.2.3. Alternative L3 – Land Sale

The effects related to the selected land would be the same as under Alternative L2. The BLM would not administer the special status plant species or their habitat at the offered lands, and the BLM ranch management strategies would not be implemented. The effects to the offered lands would be the same as under Alternative L1.

4.4.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The effects related to the selected land would be the same as under Alternative L2. Note that a shorter length (500 feet) of the S. Creek riparian corridor would leave Federal jurisdiction compared to Alternative L2 or Alternative L3 (2,500 feet) (Figure 2.2-1). The portion of the corridor leaving Federal jurisdiction could not be subdivided or developed residentially due to the Thompson Creek and S. Creek Conservation Easement. Regardless, no effects to the Thompson and Squaw Creek corridors are reasonably foreseeable apart from those due to the MMPO alternatives (negligible effects). The effects related to the offered lands would vary proportional to the lesser amount of offered lands acquired by the US.

4.4.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The vegetation on approximately 1,500 acres of the selected land would be protected by a conservation easement (Table 4.4-3). The S. Creek riparian corridor (2,500 feet in length) that would leave Federal jurisdiction could not be subdivided or developed residentially due to the Thompson Creek and S. Creek Conservation Easement. However, there would be no disturbance to the vegetation in the corridor in the foreseeable future (negligible effects). The effects related to the offered lands would be similar to those under Alternative L4, except slightly more (by fair market value) of the offered lands would be acquired by the US (long-term, minor effect).

Table 4.4-3. Vegetation protected by conservation easement, Alt. L5.

Vegetation Cover Type/ Plant Community	(acres)[1]
GRASSLAND	
Grasslands	40.0
SEMI-DESERT SHRUBLAND	
Mountain Big Sagebrush	211.6
Mountain Mahogany	5.0
Wyoming Big Sagebrush	85.6
MESIC SHRUBLAND	
Shrub-dominated Riparian	39.0
FOREST	
Deciduous Forest Riparian	7.6
EVERGREEN FOREST	
Douglas-fir	30.1
Douglas-fir/Pinegrass	255.7
Douglas-fir/Snowberry	634.4
Lodgepole Pine	7.2
Mixed Subalpine	170.2
Subalpine Fir	10.7
Subalpine Fir/Lodgepole Pine	19.5
TOTAL	**1,516.6**

[1] Areas do not include barren/rock or currently disturbed/road areas.

4.5. Range Resources

4.5.1. MMPO Alternatives

4.5.1.1. Alternative M1 – No Action

There would be no changes to the areas or AUMs available for grazing in any BLM allotments (Table 4.5-1., current area).

4.5.1.2. Alternative M2 – MMPO as Submitted by TCMC

There would be 172 acres of disturbance from the expansion of the Pat Hughes WRSF in the Thompson Creek Allotment. The S. Creek Allotment would not be affected (Table 4.5-1).

Table 4.5-1. Changes in grazing allotments and pastures, Alternative M2.

BLM Allotment (bold) and Pasture	Current Area (acres)	Area Decrease (acres)	Decrease (%)	Decrease (AUM)
S. Creek – Redbird	3,031	0	0	0
S. Creek – Saturday Mtn.	3,073	0	0	0
S. Creek – South Butte	3,383	0	0	0
S. Creek TOTAL	**9,487**	**0**	**0**	**0**
Thompson Creek – Lower	1,918	0	0	0
Thompson Creek – Unit 2	5,056	172	3.4	2
Thompson Creek TOTAL	**6,974**	**172**	**2.5**	**2**

Most of the land in the Thompson Creek Allotment is too steep and/or rocky to provide forage for livestock (i.e., ≤ 1 AUM/19.4 acres). Based on an analysis of NRCS Ecological Site data for the area (NRCS 2007), there would be 39 acres (2 AUMS) of reasonably productive, loamy, sagebrush-grasslands in the MMPO area. There would be 991 acres of similar land (51 AUMs) in the allotment. Construction of the Pat Hughes WRSF would thus eliminate 2 AUMs, or 4 percent of the AUMs used for livestock grazing in the Thompson Creek Allotment for a period of more than 10 years (negligible effect). This decrease would probably displace cattle from upland areas and increase grazing pressure along Thompson Creek (long-term, minor effect). The WRSFs would eventually be reclaimed, but vegetation growth would be relatively slow at the relatively high elevation of the mine (CNAP 1998); it would be a number of years before the reclaimed surface of the WRSFs would provide adequate forage for livestock or wildlife.

4.5.1.3. Alternative M3 – No Name Waste Rock Storage Facility

There would be no decrease in the land available for grazing in the S. Creek Allotment. The No Name WRSF would be on a south-facing slope in rocky terrain above Thompson Creek. The No Name and Pat Hughes WRSFs would disturb 128 acres and 150 acres, respectively, in the Thompson Creek Allotment. Other mining would disturb 3.6 acres in the Thompson Creek drainage, for a total decrease of 282 acres (3 AUMS, 6 %) available for grazing in the allotment (Table 4.5-2.) (long-term, negligible and minor effects).

Table 4.5-2. Changes in grazing allotments and pastures, Alternative M3.

BLM Allotment (bold) and Pasture	Current Area (acres)	Area Decrease (acres)	Decrease (%)	Decrease (AUM)
S. Creek – Redbird	3,031	0	0	0
S. Creek – Saturday Mtn.	3,073	0	0	0
S. Creek – South Butte	3,383	0	0	0
S. Creek TOTAL	**9,487**	**0**	**0**	**0**
Thompson Creek – Lower	1,918	0	0	0
Thompson Creek – Unit 2	5,066	282	5.6	3
Thompson Creek TOTAL	**6,974**	**282**	**4.0**	**3**

4.5.2. Land Disposal Alternatives

4.5.2.1. Alternative L1 – No Action

There would be no changes to the areas and AUMs available for grazing in any BLM allotments (Table 4.5-3., current area), or to the current grazing practices.

4.5.2.2. Alternative L2 – Land Exchange Proposal

Regarding the selected land, the BLM would dispose of 75 acres in the Redbird pasture and 123 acres in the Saturday Mountain pasture, or 198 acres (2.1 %) of the S. Creek Allotment (Table 4.5-3). Cattle graze these pastures while trailing north on S. Creek Road to higher elevation areas to the north and east. Cattle would not be able to access the riparian zone adjacent to S. Creek. However, there is no authorized grazing on the portion of the allotment that would be disposed of due to the steep and rugged terrain (BLM 2010a) (no effect). The BLM would receive administrative access (which would include BLM permittees) to use roads on property owned by TCMC to access the Saturday Mountain Pasture, including approximately 2,500 acres of Federal and State lands (long-term, major effect).

Table 4.5-3. Changes in grazing allotments and pastures, Alternative L2.

BLM Allotment (bold) or Pasture	Current Area (acres)	Area Decrease (acres)	Decrease (%)	Decrease (AUM)
S. Creek – Redbird	3,031	75	2.5	0
S. Creek – Saturday Mtn.	3,073	123	4.0	0
S. Creek – South Butte	3,383	0	0.0	0
S. Creek TOTAL	**9,487**	**198**	**2.1**	**0**
Thompson Creek – Lower	1,918	616	32.1	22
Thompson Creek – Unit 2	5,056	1,356	26.8	19
Thompson Creek TOTAL	**6,974**	**1,972**	**28.3**	**41**

There would be a decrease of 616 acres in the Lower pasture and 1,356 acres in the Unit 2 pasture, or 1,972 acres (28 %) of the Thompson Creek Allotment. The decreased area in the Lower pasture would contain 430 acres suitable for grazing (22 AUMs). The decreased area in the Unit 2 pasture would contain 362 acres suitable for grazing (19 AUMs). Therefore, 792 of 991 acres (80 %) suitable for grazing and 41 of 51 AUMS (80 %) would not be available for grazing (long-term, major effect). Such a large decrease would change the overall distribution of cattle in the allotment, with cattle more likely to congregate along Thompson Creek (the primary source of the remaining 10 AUMs). It would not be economically feasible for a livestock operator to graze cattle on the Thompson Creek Allotment because of the resources needed to meet resource objectives for Thompson Creek. Therefore, grazing would not be authorized for any of the AUMs in the Thompson Creek Allotment (long-term, major effect). In addition, the Thompson Creek and S. Creek Conservation Easement would not allow grazing (10 AUMs) within the Thompson Creek riparian corridor (long-term, minor effect to range resources that would be acquired by TCMC).

The BLM would authorize approximately 2,400 AUMs (~ 120 AUMs less when BWR-7 would be rested) on the irrigated land at the Broken Wing Ranch, which is the current amount of use on the ranch. In addition, the unfenced rangeland at the ranch would continue to be grazed as part of the adjacent BLM allotments (negligible effects to range resources but a long-term, minor effect to the sizes of the allotments) (Section 4.12.2.2). A few small areas of the ranch may not be irrigated, e.g., an area developed as a campground. Subparcel BWR-7 (no hay production) would be rested at times from grazing and managed with a focus on weed eradication. During such times there would be a temporary reduction of 120 AUMs (5 % of the total AUMs) (short-term, minor effect). There would be an increase in the number of vehicles and people at the ranch, which would disturb the relatively confined cattle, especially from proximal firearm discharge. There would also probably be some conflicts between public use of the ranch and the agricultural/grazing activities, e.g., gates not properly opened or closed, damage to crops, etc. (long-term, minor or moderate effects).

Under Alternative L2-B range resources would be not utilized at the ranch, which would mean 2,400 AUMs would need to be utilized elsewhere (long-term, major effect).

The Garden Creek property, because it is not fenced, would continue to be grazed when the adjacent Federal allotments are grazed (no effect). In the long term the BLM would probably inventory the property, conduct a land health assessment, determine the available grazing resources, and establish the available AUMs, the stocking rate, and the kind and class of livestock. Such would probably (administratively) increase the available AUMs of the Old Tom Allotment from 473 to 545 AUMs (15 %) (no effect to range resources but a long-term, moderate effect to the size of the allotment) (Section 4.12.2.2).

4.5.2.3. Alternative L3 – Land Sale

The same effects for the selected land would be the same as under Alternative L2, unless the land was sold to a party other than TCMC. In such case the BLM would not obtain a grant from TCMC to the BLM for administrative access (including BLM permittees) to use roads on private property owned by TCMC to reach the Saturday Mountain pasture (long-term, major effect). The range resources of the offered lands would not come under BLM administration (long-term, moderate effect).

4.5.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

Compared to Alternative L1, there would be decreases in the areas of the S. Creek Allotment (3 acres) and Thompson Creek Allotment (1,878 acres). The decreased area in the Lower pasture would contain 344 acres suitable for grazing (17 AUMs), and the decreased area in the Unit 2 pasture would contain 362 acres suitable for grazing (19 AUMs). Therefore, 706 of 991 acres (71 %) suitable for grazing and 36 of 51 AUMS (69 %) would not be available for grazing (long-term, major effect) (Table 4.5-4). Compared to Alternative L2, there would be less range resources that would come under BLM administration as portions of the ranch and/or Garden Creek property would not be acquired by the US (long-term, minor effect).

Table 4.5-4. Changes in grazing allotments and pastures, Alternative L4.

BLM Allotments (bold) and Pastures	Current Area (acres)	Area Decrease (acres)	Decrease (%)	Decrease (AUM)
S. Creek – Redbird	3,031	2	< 1	0
S. Creek – Saturday Mtn.	3,073	1	< 1	0
S. Creek – South Butte	3,383	0	0	0
S. Creek TOTAL	**9,487**	**3**	**< 1**	**0**
Thompson Creek – Lower	1,918	522	27.2	17
Thompson Creek – Unit 2	5,056	1,356	26.8	19
Thompson Creek TOTAL	**6,974**	**1,878**	**26.9**	**36**

4.5.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects related to the selected land would be the same as for Alternative L2 (long-term, major effects) (Table 4.5-3). The effects related to the offered lands would be the same as for Alternative L4, but slightly more offered lands would come under BLM administration.

4.6. Water Resources

4.6.1. MMPO Alternatives

4.6.1.1. Alternative M1 – No Action

Surface Water

The quantity and/or the quality of surface water may be affected by the project compared to current conditions. The effects to quantity can be either a reduction in flow or contribution to flow (e.g., capturing groundwater using cutoff walls) or an increase in flow (e.g., ceasing to withdraw water for mining). The effects to quality are primarily evaluated during low flow when there is relatively low dilution capacity. Water quality during high flow is also discussed. Only the concentrations of constituents that are known to be elevated in the various mine waters are discussed in detail in the FEIS. The future effects described in this section are based on monitoring data, and supported by the results of an extensive study conducted by TCMC's consultants, which included climate, hydrologic, mine waste, and geologic characterizations; numerical calculations from geochemical and hydrogeological modeling; pit lake modeling; water balance development considering the planned water management; and use of receiving stream/mine water mixing calculations. The models used in the assessment were empirically derived and therefore provide a relatively high degree of confidence in support of the overall assessment.

The effects to water quality (chemistry) during baseflow conditions were evaluated under various conservative assumptions. In cases where *best* estimates and *upper* estimates were calculated, the best estimates are considered the reasonably foreseeable values whereas the upper estimates are the maximum plausible/worst-case values. The effects are summarized below from two regulatory aspects: 1) whether the water quality would meet relevant beneficial use criteria established by the WQSs; and 2) whether the water quality would likely comply[3] with antidegradation policy that is part of the WQSs (Section 3.6.1.1). Under the antidegradation rule, a stream with water quality better than the minimum quality set by the beneficial use criteria may be managed to maintain the current quality unless degradation is allowed following a public review of social and economic tradeoffs. In the case of Alternative M1 (No Action), predicted incidents of problematic water quality are isolated, infrequent, and only occur under the most conservative scenarios. Also note that the frequency of low-frequency events such as extreme floods or the probabilistic 7Q10 flow (lowest 7 day flow that is likely to occur on average once every 10 years) is inherently uncertain.

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[3] It is not possible to determine exactly by what means IDEQ would perform the antidegradation analysis. The FEIS performs a proxy analysis using the existing data statistics and IDEQ guidance; neither may ultimately be used by IDEQ. Thus, the FEIS analysis should only be used for comparative purposes between alternatives. Actual antidegradation calculations performed by IDEQ could result in better or worse conditions than predicted here.

During mining and after reclamation a number of structures would continue to hold and/or convey stormwater and/or other mine water. These structures are/would be designed to manage at least the 100 year/24 hour, 500 year/24 hour, or, in the case of the TSF, the probable maximum flood (Section 2.1.1.6., Section 2.1.1.8., Section 2.1.3.6., Section 2.1.4.8., Section 3.6.1.1). Of these structures, the two Bruno Creek sedimentation ponds – designed for the 100 year/24 hour storm – would have the greatest potential for the uncontrolled release of water during extreme flood events (until the ponds would be removed when berms along the Bruno Creek Road would no longer be required by the MSHA). The drainage intercepted by these sediment ponds is largely controlled by the TSF, which is designed to contain the probable maximum flood. The incremental effect on these ponds is therefore relatively small. However, any uncontrolled release of water from these facilities would be managed as it currently is, with the same effect to water quantity or quality (likely negligible due to dilution in receiving streams that are also likely to be experiencing high flows, with no resultant exceedance in WQSs).

Water quality effects at the mine would in part arise from ARD. However, where it would occur, it would in large part be controlled with the water management system. In general, the Pat Hughes WRSF began producing ARD in the mid-2000s. The Buckskin WRSF does not produce ARD, but some pockets of Type 2 waste rock in the facility could eventually produce ARD. The TSF has different ARD characteristics for the impoundment and the embankment: there is no potential for ARD in the tailings slimes and sands within the impoundment due to saturated and anoxic storage conditions, but the embankment sands may become acid generating in the future. Effects to water quantity (Figure 4.6-1.) are limited to collection of groundwater associated with the implementation of groundwater cutoff (vertical slurry) walls (Figure 4.6-2., Figure 4.6-3). Effects to water quality are limited to the very small portion of groundwater that may bypass groundwater cutoff (vertical slurry) walls (Section 4.6.1.1.2). The effects to water resources related to the Buckskin and Pat Hughes WRSFs do not consider capping during reclamation, as described for Alternative M1 or Alternative M2 (Section 2.4.1.8.), as capping is not expected to alter the behavior of affected seepage and performance of cutoff walls within the groundwater systems below these facilities.

Thompson Creek and Tributaries

Low-flow Conditions

The effects to surface water under Alternative M1 would be the net effects of the groundwater cutoff walls and other water management practices. The cutoff walls would reduce the flow in Thompson Creek (long-term, negligible or minor effect), but would be expected to prevent the majority of WRSF constituent loadings (loadings equate to the product of concentration and flow) from reaching Thompson Creek, as described further below. A mass loading approach was used to conduct a sensitivity analysis of effects on Thompson Creek water quality. The sensitivity analysis approach is described below and included a range of concentrations of constituents in seepage water from the WRSFs (best and upper estimates), groundwater flow rates bypassing the cutoff walls, and low-flow conditions in Thompson Creek.

Source	Description	Flow Estimates best	Flow Estimates upper
a	Buckskin cutoff seepage - colluvium (gpm)	0.002	0.166
	Buckskin metasediment groundwater (gpm)	1.59	1.59
b	Pat Hughes cutoff seepage - colluvium (gpm)	0.005	0.38
	Pat Hughes metasediment groundwater (gpm)	11.1	11.1
c	Seepage via Redbird (gpm)*	35	35
d	Seepage via Bruno (gpm)**	3.9	8.0
e	Treated water (cfs) via outfall 005 after year 30	2.04	2.04

*only during years 1-5 ** during years 6-plus

Receiving stream **annual low flows,** *7q10*

Internal sources with no direct discharge

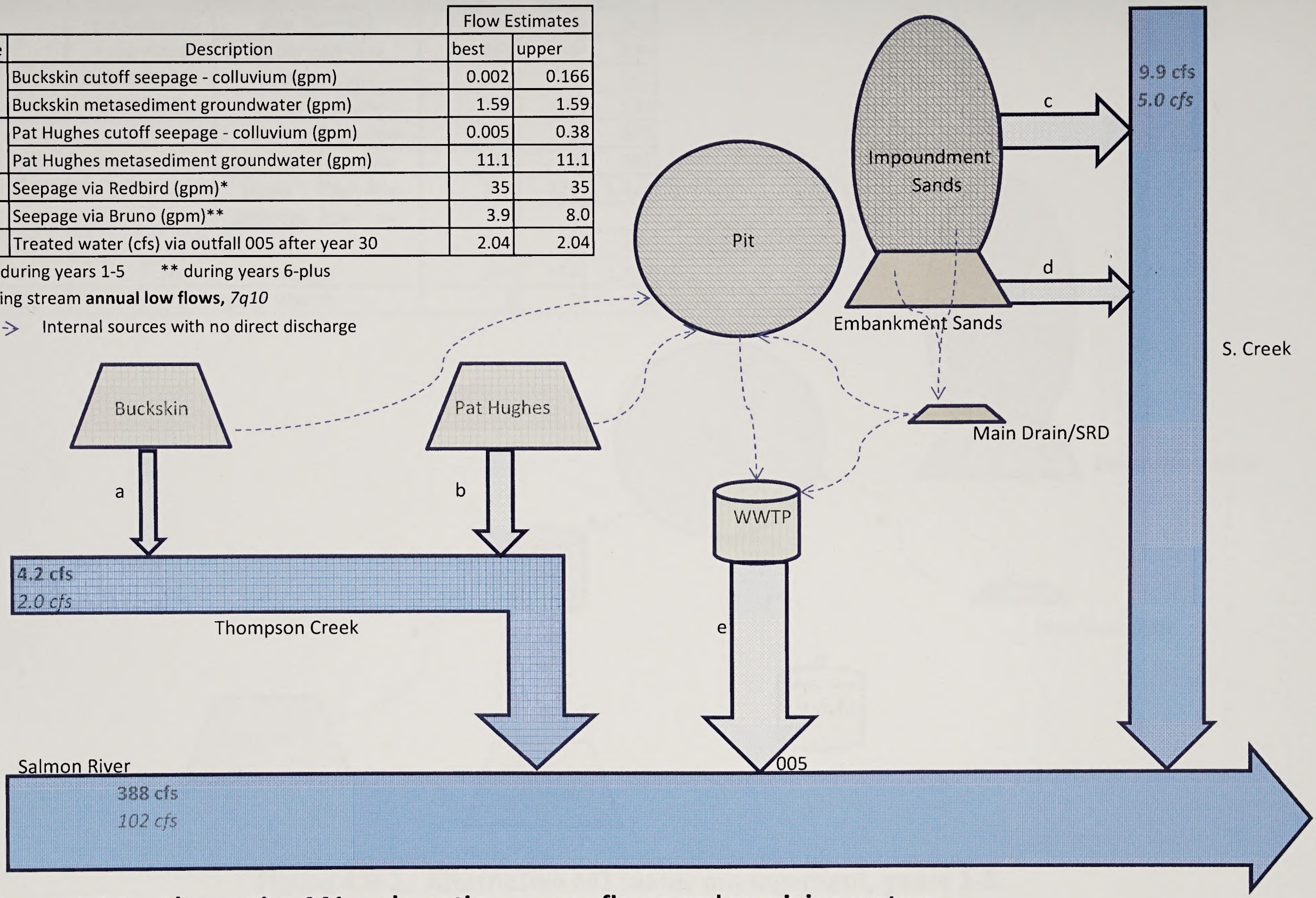


Figure 4.6-1. Alternative M1 reclamation source flows and receiving waters.

Flow Arrow	Description			Average (gpm)	Range (gpm)	
					Min	Max
a	Buckskin to Lime Plant	Best Estimate		54	0	361
		Upper Estimate		169	55	934
b	Pat Hughes to Lime Plant	Best Estimate		125	64	581
		Upper Estimate		125	64	581
c	Lime Plant to Pit	Best Estimate	high flow	110	0	486
			low flow	70	0	581
		Upper Estimate	high flow	295	123	1,414
			low flow	0	0	0
d	Runoff to Pit			23	6	201
e	Main Drain Seepage			739	456	1,385
f	Discharge to WWTP			0	0	0

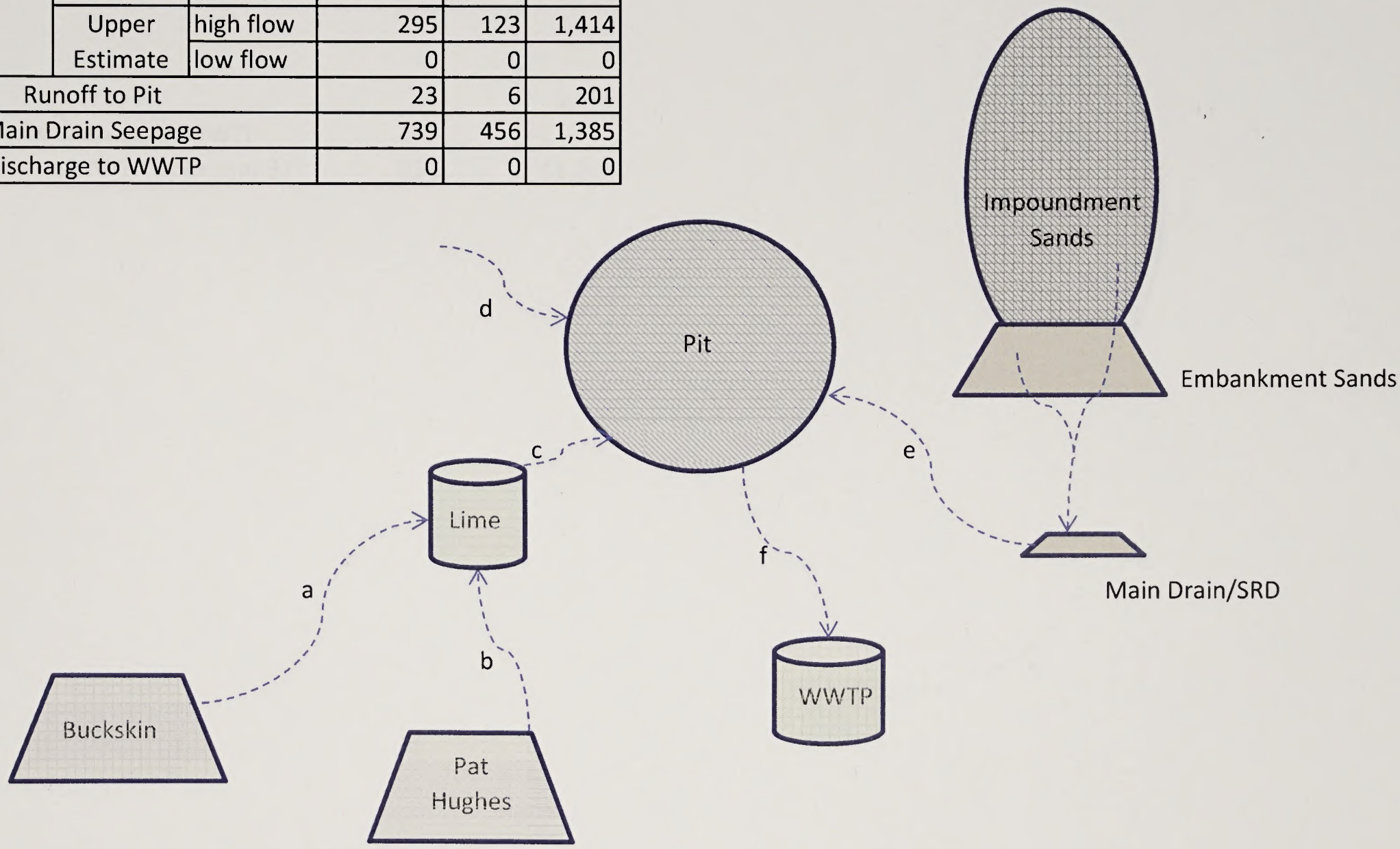


Figure 4.6-2. Alternative M1 water management, years 1-5.

Flow Arrow	Description			Average (gpm)	Range (gpm)	
					Min	Max
a	Buckskin to Lime Plant	Best Estimate		52	0	406
		Upper Estimate		224	45	1,580
b	Pat Hughes to Lime Plant	Best Estimate		217	54	1,532
		Upper Estimate		217	54	1,532
c	Lime Plant to Pit	Best Estimate	high flow	115	0	1,082
			low flow	141	0	1,532
		Upper Estimate	high flow	423	104	3,099
			low flow	0	0	0
d	Runoff to Pit			80	5	1,566
e	Main Drain Seepage to WWTP			145	---	
f	Pit Discharge to WWTP from year 31			636	0	11,938

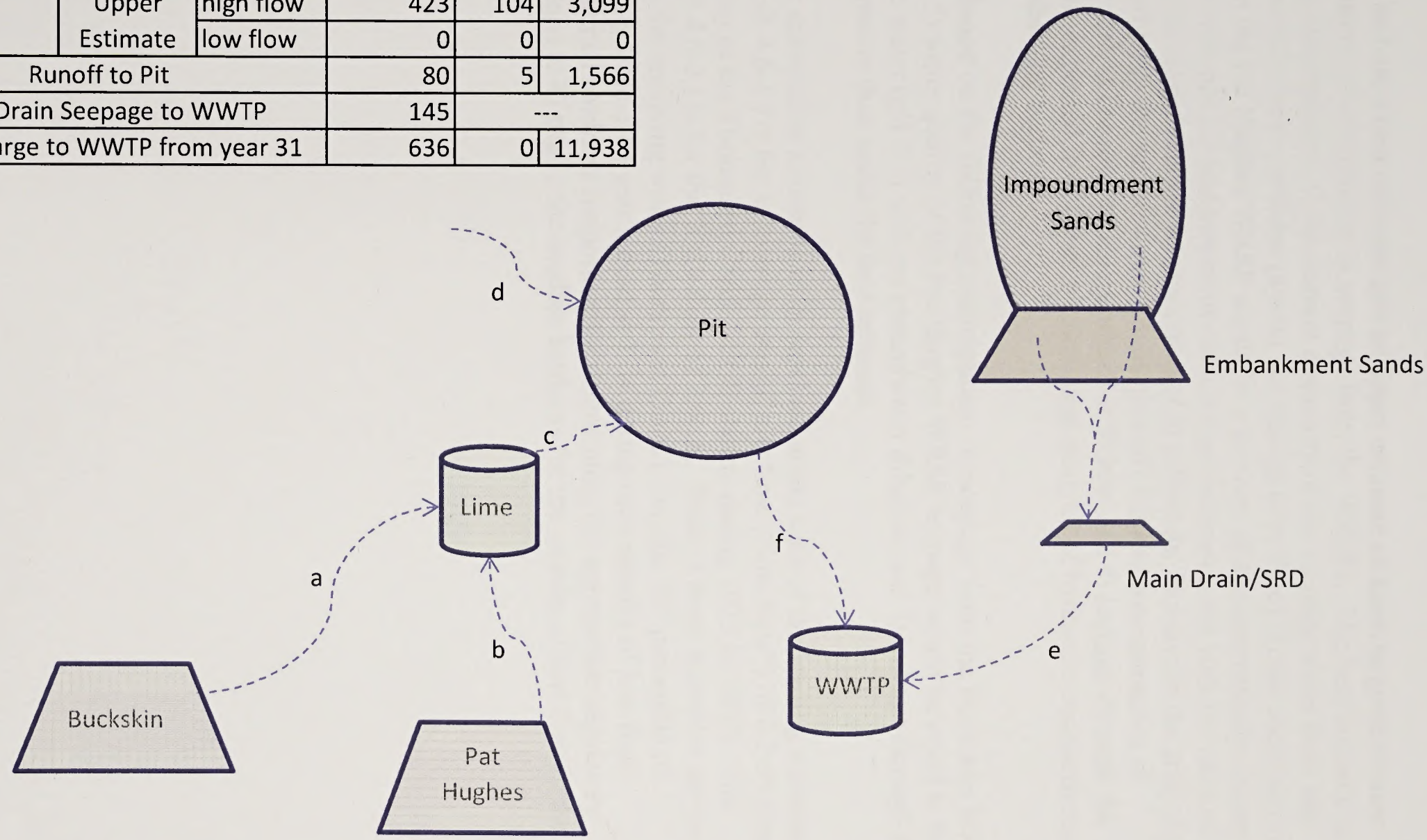


Figure 4.6-3. Alternative M1 water management, years 6-plus.

The loading scenarios include a best estimate and an upper estimate of loads to groundwater based on the concentrations of constituents in seepage from the WRSFs. The best estimate is based on the following assumptions: 1) the current chemistry of the seepage water from the Buckskin WRSF is at steady-state condition (would not change over time); 2) the chemistry of the seepage water from the Pat Hughes WRSF would be a mixture of a conservatively chosen Pat Hughes pore water with pH 3.5 and non-mine-affected groundwater, but with the ratio of Pat Hughes pore water increased relative to groundwater to reflect the increase in the area of the WRSF for each alternative; 3) the mixed water would have pH 4.5 and concentrations of constituents similar to current concentrations measured at PHtoe; and 4) leakage through the cutoff wall would be the expected flow based on statistical analysis of hydraulic conductivities of the cutoff wall and underlying bedrock.

The upper estimate is based on the following assumptions: 1) seepage from the Buckskin WRSF would become acidic; 2) water quality of the Pat Hughes WRSF seepage would be equal to that of the Pat Hughes pore water (pH 3.5) with no groundwater dilution; and 3) leakage through the cutoff wall would be greater than under the best estimate.

Two Thompson Creek streamflow scenarios were assessed under each of the loading scenarios. The first scenario (Table 4.6-1.) is for an average annual low flow ("low flow") of 4.2 cfs (from average flows in January at the Thompson Creek USGS station during 1973 to 2009). The second scenario (Table 4.6-2.) is for the 7Q10 flow of 2.0 cfs. Both of these scenarios use the same water quality for the receiving water (Thompson Creek), i.e., the 95th percentile of background water quality from a 10 year record at TC4 during only months of low flow (Table 4.6-1). The assumed hardness (important for determining the appropriate regulatory criteria for certain metals) is 47 mg/L, the median hardness for the months of low flow in the data at TC4.

Table 4.6-1. Thompson Creek water quality, low flow, Alternative M1.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Thompson Creek Receiving Water Quality	Predicted Thompson Creek Water Quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	14	15.7	16.3	N/A	N/A
Al	8.8	8.9	29.9	N/A	N/A
As	0.5	0.5	0.5	340	150
Cd	0.05	0.05	0.07	0.71	0.37
Co	0.1	0.10	0.57	N/A	N/A
Cu	0.8	0.81	1.54	8.4	6.0
Fe	30	30	30	N/A	N/A
Pb	0.075	0.08	0.10	28	1.1
Mn	0.48	0.5	24.3	N/A	N/A
Mo	2.07	2.1	2.1	N/A	N/A
Ni	0.46	0.5	0.5	247	27
Se-T	1.95	2.0	2.0	20	5
U	1	1.0	1.2	N/A	N/A
Zn	3	3.0	5.1	62	62

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 47 mg/L

Table 4.6-2. Thompson Creek water quality, 7Q10 flow, Alternative M1.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Thompson Creek Receiving Water Quality	Predicted Thompson Creek Water Quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	14	17.4	18.8	N/A	N/A
Al	8.8	9.1	53.1	N/A	N/A
As	0.5	0.5	0.5	340	150
Cd	0.05	0.05	0.10	0.71	0.37
Co	0.1	0.10	1.08	N/A	N/A
Cu	0.8	0.81	2.35	8.4	6.0
Fe	30	30.1	31	N/A	N/A
Pb	0.075	0.08	0.12	28	1.1
Mn	0.48	0.6	50.5	N/A	N/A
Mo	2.07	2.2	2.2	N/A	N/A
Ni	0.46	0.5	0.5	247	27
Se-T	1.95	2.0	2.0	20	5
U	1	1.0	1.4	N/A	N/A
Zn	3	3.0	7.4	62	62

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 52 mg/L

Under all analyzed scenarios, the water quality of Thompson Creek would meet all numeric WQSs. Of the constituents evaluated for antidegradation considerations, all would be under the 10 percent threshold (the assimilative capacity – a concentration 10 % greater than the 95th percentile of the current concentration) under all analyzed scenarios except for the low flow/upper estimate – copper, and the 7Q10 flow/upper estimate – copper and cadmium. These exceptions would be categorized as *significant degradation* under this analysis (in the context of IDEQ regulations and not NEPA analysis).

High-flow Conditions

NPDES Outfall 001 and Outfall 002 would continue to be used when the flow and chemistry of the discharged water would meet the NPDES permit conditions. When water does not meet these conditions, it would be retained on site and/or discharged at Outfall 005 after treatment. In some instances, however, there would still be the potential for permit limit exceedances at these

outfalls during spring run-off (long-term, infrequent, minor effect). These isolated exceedances would most likely be related to TSS and would not be expected to have any more than a very short-term, minor effect on Thompson Creek water quality.

S. Creek and Tributaries

There would be negligible changes to the flows of Bruno Creek or Redbird Creek during mining. After milling is completed, water in upper Bruno Creek would no longer be collected for processing, and would flow more consistently into lower Bruno Creek below the TSF embankment, increasing streamflow. However, the variations in flow in lower Bruno Creek would generally be within the range of the current variations. Redbird Creek would have reduced flow when the seepage to the stream from the TSF decreases (long-term, minor effects). Neither of these effects would cause more than a negligible effect to the flow of S. Creek. TCMC has water rights to use 6.3 cfs from S. Creek for irrigation, but it is unknown how much of this right is used each year (except that the water can be diverted only during high flow). It is assumed that such water would be diverted for the foreseeable future.

Low-flow Conditions

The water quality of S. Creek, which includes some seepage from the TSF, and the water quality of Bruno Creek would be the same throughout mining. The sulfate and chloride loads to Redbird Creek from the TSF would continue during mining, but would have negligible effects to S. Creek. There is not sufficient data to evaluate in detail the effect of the TSF on the water quality of Redbird Creek. However, there would likely be varying degrees of degradation depending on the constituent. Considering that the average annual low flow and the 7Q10 flow in Redbird Creek might be two orders of magnitude lower than in Squaw Creek, Redbird Creek would have much less ability to dilute metal loads from the TSF. The concentration of sulfate, e.g., might be an order of magnitude greater at the mouth of Redbird Creek than that predicted in S. Creek (best estimate, average annual low flow during Phase 8). In contrast, the concentration of copper, which does not appear to elevated in the TSF water, might be similar in both Redbird Creek and S. Creek. After reclamation the TSF would gradually dewater with reduced seepage into groundwater, reducing or eliminating the sulfate and chloride loads to Redbird Creek. The TSF has been designed so that the tailings slimes are not expected to oxidize. They have ample alkalinity to prevent the formation of acidic mine drainage within the impoundment. The acidic seepage predicted to occur from the TSF embankment (as opposed to from the impoundment) would not affect the water quality of Redbird Creek as the embankment is not hydraulically connected to Redbird Creek. Seepage from the embankment would be captured by the pumpback system below the SRD and is not expected to affect Bruno Creek.

The water quality of S. Creek was evaluated in the same manner as for Thompson Creek, with an annual average low flow of 9.9 cfs (from average flows in January at the S. Creek USGS station during 1973 to 2009) and an estimated 7Q10 flow of 5.0 cfs. There is no water quality data for S. Creek upstream of Redbird Creek to establish background conditions. Therefore, the background water quality of the receiving water (S. Creek) was set as the 95th percentile of the 10 year record of water quality from the months of low flow at the downstream S. Creek site (SQ2) (that includes loads from Bruno Creek and Redbird Creek) (Table 4.6-3). Therefore, the

concentrations of constituents in the water quality predictions would probably be overestimated as the loads would potentially be double-counted.

Loads to S. Creek would be from only potential seepage from the TSF embankment. As a conservative assumption the embankment is predicted to become acid generating after reclamation in the long term. The conservative effects analysis assumed that some portion of the embankment seepage would enter S. Creek via Bruno Creek. Following tailings consolidation, seepage to Redbird Creek from the impoundment would be negligible. As a result, loadings to S. Creek via Redbird Creek would be negligible in the long term.

The best-estimate scenario is based on the following assumptions: 1) the chemistry of the impoundment seepage water entering Redbird Creek is that of the median concentrations of constituents in water from the main drain in 2010; 2) the amount of seepage entering Redbird Creek would be the predicted amount of seepage from the impoundment; 3) the seepage to Bruno Creek is seepage from embankment sands that have become acid generating and are not diluted; and 4) the seepage flow to Bruno Creek is based on hydraulic conductivities and gradients of groundwater flows derived from monitoring well data. The upper-estimate scenario is based on the same assumptions as for the best-estimate scenario except: 1) the chemistry of the seepage water entering Redbird Creek is that of the maximum concentrations of constituents in water from the main drain in 2010, and 2) the seepage flow to Bruno Creek is twice that of the best estimate.

In addition, the water quality of S. Creek was evaluated for the first 5 years after mining and milling is completed, when tailings consolidation seepage flows would be delivered to the pit (Table 4.6-3.) and for the years after that when tailings consolidation is complete (Table 4.6-4). For Years 6-plus the calculations were made with the highly conservative assumption that some seepage from the TSF would escape or bypass the water management system (i.e., Bruno Creek would receive seepage from the TSF that bypasses the SRD), even though such is not believed to occur now and would not be expected to occur in the future. The loads to Redbird Creek would occur only during Years 1 to 5 and the loads to Bruno Creek would occur only during Years 6-plus.

There would be no exceedances of numeric WQSs for S. Creek except under the Years 6-plus, conservative 7Q10 flow/upper estimate for which the concentration of cadmium (1.11 µg/L) would be slightly greater than the CCC (0.74 µg/L) (long-term, infrequent, moderate or major effect). Should such exceedance occur, the IDEQ would require appropriate studies to better document the effects to water quality/water resources, and, if necessary, prescribe remedial actions. In situations like this, isolated instances of instream water quality exceeding a numeric WQS, in and of themselves, may not be considered a violation of State law.

Regarding antidegradation, the concentrations of all considered constituents would be under the 10 percent threshold (*insignificant degradation* in the context of IDEQ regulations) for S. Creek under all Year 1 to 5 scenarios. The concentrations would be greater than the threshold for all Years 6-plus scenarios: low flow/best estimate – copper and cadmium; low flow/upper estimate – copper, cadmium, and zinc; 7Q10 flow/best estimate – copper, cadmium, and zinc; and 7Q10/flow upper estimate – copper, cadmium, zinc, and nickel (long-term, infrequent, minor effects).

Table 4.6-3. S. Creek water quality, Years 1-5, Alternative M1.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing S. Creek Receiving Water Quality	Predicted S. Creek Water Quality Low Flow		Predicted S. Creek Water Quality 7Q10 Flow		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate	Best Estimate	Upper Estimate		
SO_4^{2-}	75	85	86	94	96	N/A	N/A
Al	26	26	26	26	26	N/A	N/A
As	0.96	0.98	1.00	0.99	1.04	340	150
Cd	0.05	0.05	0.05	0.05	0.05	1.96	0.74
Co	0.14	0.18	0.18	0.21	0.22	N/A	N/A
Cu	0.53	0.53	0.57	0.53	0.61	26	16.7
Fe	30	50	60	70	90	N/A	N/A
Pb	0.1	0.10	0.10	0.10	0.10	105	4.1
Mn	2.5	41	42	79	81	N/A	N/A
Mo	2.8	2.8	2.8	2.8	2.8	N/A	N/A
Ni	1.3	1.4	1.4	1.5	1.5	686	76
Se-T	1	1.0	1.0	1.0	1.0	20	5
U	1	1.0	1.1	1.1	1.1	N/A	N/A
Zn	2.5	2.5	2.6	2.6	2.7	172	173

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 157 mg/L

Table 4.6-4. S. Creek water quality, Years 6-plus, Alternative M1.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing S. Creek Receiving Water Quality	Predicted S. Creek Water Quality Low Flow		Predicted S. Creek Water Quality 7Q10 Flow		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate	Best Estimate	Upper Estimate		
SO_4^{2-}	75	77	79	79	82	N/A	N/A
Al	26	40	54	54	82	N/A	N/A
As	0.96	0.98	1.00	1.00	1.03	340	150
Cd	0.05	0.32	0.59	0.58	1.11	1.96	0.74
Co	0.14	0.53	0.92	0.92	1.70	N/A	N/A
Cu	0.53	2.22	3.92	3.89	7.25	26	16.7
Fe	30	31	32	32	33	N/A	N/A
Pb	0.1	0.19	0.28	0.28	0.46	105	4.1
Mn	2.5	25	47	47	91	N/A	N/A
Mo	2.8	2.8	2.8	2.8	2.8	N/A	N/A
Ni	1.3	3.2	5.1	5.1	8.8	686	76
Se-T	1	1.0	1.0	1.0	1.0	20	20/5
U	1	2.0	3.0	2.9	4.9	N/A	N/A
Zn	2.5	14.1	25.7	25.5	48.5	172	173

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 157 mg/L

High-flow Conditions

The TSS and turbidity in S. Creek would be the same as present. During reclamation, despite erosion and sediment controls, there would be increased potential during storm events for sediment delivery to S. Creek from large areas of construction activities (e.g., the TSF) (short-term, minor effect; long-term negligible effect). However this sediment delivery is not likely to cause exceedances of WQS.

Salmon River

The rates of dewatering the open pit during mining would increase from 300 gpm to 358 gpm, a negligible effect because the additional water would reduce the amount of make-up water taken from other sources. After reclamation or during interim management there would no longer be make-up water withdrawn from the Salmon River for the mill (up to 4.5 cfs utilized out of a

20.89 cfs water right). Not removing this quantity of water from the Salmon River during low flow such as the 7Q10 flow (103 cfs) would be a long-term, minor effect. During average and high flow not removing such water would be a negligible effect.

After reclamation the pit dewatering would cease and the pit would be used to store water collected by the water management system, e.g., water from the TSF main drain and, most importantly from a volume perspective, treated water (via an initial lime treatment plan to ensure the pH in the flooded pit remains neutral) from both WRSFs. A pit lake would gradually develop, with the water surface reaching an elevation of 7,030 feet in approximately 30 years. At that time, water would be pumped from the lake to avoid seepage via an early 1970s exploration tunnel that intersected the pit wall at an elevation of 7,040 feet (the tunnel has been sealed but TCMC wants to ensure uncontrolled seepage does not occur). The lake would be a permanent open water feature, but would not function ecologically as it would be maintained as a managed water facility (Table 4.6-5.) (long-term effect that is necessary to ensure that WQS in receiving streams will be met).

Table 4.6-5. Final pit lake water chemistry (complete mixing).
all units are µg/L except mg/L for SO_4^{2-}

Parameter	Alternative M1	Alternative M2
SO_4^{2-}	1,200	1,100
As	5.2	3.5
Cd (III/IV)	12	8.5
Cu	160	99
Fe	390	290
Mn	7,300	5,500
Mo	400	250
Ni	19	13
Pb	10	7.4
Se-T	20	20
Zn	730	450

Water pumped from the lake would be treated in a second treatment plant (lime neutralization/clarification/filtration), similar to the current PWTP, and would be suitable for discharge to the Salmon River via NPDES Outfall 005 (Table 4.6-6). Seepage from the SRD would be sent to the second treatment plant. The plant would discharge at an estimated average rate of 914 gpm (2.04 cfs), which would be 0.5 percent of the average annual low flow in the Salmon River during the winter months (388 cfs) (Section 3.6.) (negligible effect). The current NPDES permit does not specify a limit on a discharge rate for Outfall 005, but instead specifies dilution ratios that must be achieved in the Salmon River. When the river flows are 2,000 cfs or less, the ratio must be greater than or equal to 120, a value derived in part from the IDEQ mixing

model (IDEQ 2000). The dilution ratio would be achieved under normal winter low flow (400 cfs), but would not be met for the 7Q10 flow (103 cfs). During these low flow periods, if at all possible, water would be stored in the pit and would not be discharged to the Salmon River as necessary to comply with receiving water standards. However, during extreme periods of low flow the discharge would likely be matched to the Salmon River hydrograph to comply with the dilution ratio. Regardless, the discharge rate of 2.04 cfs would be a negligible effect to the flow of the Salmon River even during the 7Q10 flow.

Table 4.6-6. NPDES Outfall 005 water quality.
all units are µg/L except mg/L for SO_4^{2-} and s.u. for pH

Parameter	Alternative M1
pH	8.7
SO_4^{2-}	1,150
Al	2,150
As	< 0.1
Cd	0.8
Co	6.4
Cu	2
Fe	< 30
Pb	< 0.05
Mn	3,470
Mo	30.8
Ni	2.3
Se	29
U	20
Zn	15

Regardless of the predicted water quality, all discharge to Outfall 005 would need to meet whatever NPDES permit limits (renewed every 5 years) were in effect at the time of discharge: "the outfall 005 discharge must not result in a reduction of the ambient water quality of the Salmon River as measured below the mixing zone" (TCMC NPDES permit, EPA 2007).

The above-described water quality of Thompson Creek, S. Creek, and at NPDES Outfall 005 were used to estimate the water quality for the Salmon River downstream of its confluence with S. Creek for the average annual low flow (388 cfs) and 7Q10 flow (103 cfs) (Table 4.6-7., Table 4.6-8). The background water quality of the receiving water (Salmon River) was set as the 95th percentile of the 4 year record of water quality from only the months of low flow at SR3. The numeric WQSs would be met for all of the scenarios (negligible effect). Note that the current NPDES limits (not assessed below as the limits are all at or above the WQSs) are for the

concentrations of total metals (dissolved and present on suspended particles in the water), whereas the predicted water quality and WQSs are based on only the concentrations of dissolved metals (except for selenium, see Table 4.6-7, note 1). The differences between the concentrations of total and dissolved metals in the treated water would be very small because of the low concentrations of particles in the treated water (i.e., settled lake water that has been further clarified and filtered), but these differences would need to be considered in the future, because it would be part of the IDEQ mixing analysis for the NPDES permit.

Table 4.6-7. Salmon River water quality, low-flow, Alternative M1.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Salmon River Receiving Water Quality	Predicted Salmon River Water Quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	8.6	16.7	16.8	N/A	N/A
Al	10.6	23.0	23.6	N/A	N/A
As	1.57	1.6	1.6	340	150
Cd	0.050	0.06	0.07	0.9	0.43
Co	0.100	0.15	0.16	N/A	N/A
Cu	0.40	0.48	0.53	10.8	7.5
Fe	30.0	31.3	31.3	N/A	N/A
Pb	0.050	0.06	0.06	38	1.5
Mn	1.87	20.8	21.6	N/A	N/A
Mo	2.8	3.1	3.1	N/A	N/A
Ni	0.6	0.70	0.75	312	35
Se-T	1.0	1.2	1.2	20	5
U	2.0	2.2	2.2	N/A	N/A
Zn	3.7	4.2	4.5	78	79

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 62 mg/L

Table 4.6-8. Salmon River water quality, 7Q10 flow, Alternative M1.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Salmon River Receiving Water Quality	Predicted Salmon River water quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	8.6	35.6	35.8	N/A	N/A
Al	10.6	56.1	58.4	N/A	N/A
As	1.57	1.6	1.6	340	150
Cd	0.050	0.10	0.12	0.9	0.43
Co	0.100	0.27	0.33	N/A	N/A
Cu	0.40	0.64	0.84	10.8	7.5
Fe	30.0	32.7	32.8	N/A	N/A
Pb	0.050	0.07	0.08	38	1.5
Mn	1.87	73.1	76.3	N/A	N/A
Mo	2.8	3.6	3.6	N/A	N/A
Ni	0.6	0.90	1.08	312	35
Se-T	1.0	1.7	1.7	20	5
U	2.0	2.6	2.7	N/A	N/A
Zn	3.7	5.3	6.5	78	79

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 62 mg/L

Regarding antidegradation, the concentrations of all of the constituents would be less than the 10 percent threshold for the Salmon River under all analyzed scenarios except for the 7Q10 flow/best estimate – cadmium and selenium, and the 7Q10 flow/upper estimate – cadmium and selenium (long-term, infrequent, minor effects). However, as noted previously, the discharge from Outfall 005 could potentially be managed as necessary to avoid discharge during extreme low flow conditions and to avoid degradation of Salmon River water quality.

Open Pit

The rock at the TCM open pit contains low concentrations of sulfide minerals (i.e., typically < 1 % sulfur) and metals (e.g., ~ 0.1 % molybdenum and < 0.005 % copper in the ore; much lower concentrations in the waste rock) (Doughty 2012). For example, in contrast the rock at the Berkeley open pit in Butte, Montana contains high concentrations of sulfide minerals (i.e., ~ 4 % sulfur) and metals (e.g., 0.8 % copper). More importantly, the Berkeley Pit is connected to 10,000 miles of underground workings in rock containing extremely high concentrations of

sulfide minerals (e.g., > 30 % sulfur in places) and metals (e.g., up to 80 % copper). As a result, the water in the Berkeley pit is very acidic (~ pH 2.5) and contains as much as 1,000,000 µg/L iron and 200,000 µg/L copper (Gammons and Duaime 2006; Gammons et al. 2006; Luoma et al. 2008, MBMG 2013), whereas the water in the TCM pit is neutral (pH 7.2 to pH 7.5) and contains 500 µg/L iron and 2.5 µg/L copper (Doughty 2012). Pit lake water quality will be managed to ensure neutral conditions (and as a result lower concentrations of metals) persist in the long-term. During long-term water treatment at the TCM, the pit would continue to have neutral pH and very low concentrations of metals (e.g., 300 µg/L iron and 100 µg/L copper) compared to the extremely high concentrations of metals in the Berkeley Pit. The water released from the TCM pit would be alkaline (pH 8.7) and have even lower concentrations of metals, e.g., 5.5 µg/L iron and 2 µg/L copper. For reference, the EPA primary drinking water standard for copper is 1,300 µg/L (EPA 2014); the Idaho WQSs (CCC exposure to aquatic life for a hardness of 100 mg/L $CaCO_3$) is 11 µg/L; the NPDES permit limit for copper for the mine is 3 to 20 µg/L depending on the flow of the receiving stream; and the typical concentration of copper in water samples collected as part of water quality monitoring at the mine is approximately 0.3 µg/L (TCMC 2013). Note also that while the effects to water quality are described as long-term, the water management system would be structured to operate in perpetuity.

Surface Water Rights

There would be no effects to water rights for surface waters. There would be no physical disruption of points of diversion or water sources associated with water rights, nor would there be any water quality issues that would prevent a water right holder from using their source water.

Groundwater

Buckskin Creek Watershed

The baseline groundwater conditions would continue, except for a reduction in constituents to Thompson Creek due to the installation of a groundwater cutoff wall downgradient of the Buckskin WRSF to capture groundwater seepage from the facility. A vertical wall of cement with a high density polyethylene (HDPE) liner would be keyed (anchored) into the bedrock at the base of the alluvial/colluvial rock layer, and would capture essentially all groundwater seepage from the facility except for small amounts of leakage through the wall (240 gallons/day) and around it (2,282 gallons/day via the metasedimentary rock). The cutoff wall would substantially reduce the loads of constituents in seepage from the WRSF (BuckC) (Table 4.6-9.) which would be delivered via groundwater (i.e., leakage around and through the wall) to Thompson Creek (Table 4.6-10). The loads were calculated using the cross-sectional area of the aquifer, the flow rates (with and without the wall) through the aquifer, and the estimates of the concentrations of constituents in the seepage from the WRSF (Buck C). Other important assumptions were summarized previously (Section 4.6.1.1.1).

The best estimate was conservatively calculated using the highest measured concentrations instead of the median concentrations in the monitoring data. The exceptions are the concentrations of sulfate and molybdenum, which were calculated from a geochemical model using solubility controls. As a result, the concentrations of sulfate and molybdenum used in the

best estimate were higher than their maximum measured concentrations in the monitoring data. The upper estimate is based on the improbable scenario that the WRSF would exhaust its ability to buffer acidity at some time in the future and become acidic. The rate of degradation of the cutoff wall over time is difficult to predict, but would vary with the amount of cracking and the chemistry of the water in contact with the wall. Regardless, the cutoff wall would be expected to operate as designed for at least 30 years (e.g., EPA 1998), and would be closely monitored and maintained/rebuilt as necessary.

Table 4.6-9. Buckskin WRSF (BuckC) water quality behind cutoff wall.
all units are mg/L except s.u. for pH

Parameter	Alternative M1 Best Estimate	Alternative M1 Upper Estimate	Measured (Max.)	Measured (Median)	Idaho Groundwater Standards
pH	7.9	**4.7**	**8.7**	8.0	6.5-8.5[2]
SO_4^{2-}	**1690**	**1868**	**1120**	**847**	250[2]
Al	0.0023	**22**	0.044	0.002	0.2[2]
Cd	0.00037	**0.024**	0.00037	0.00009	0.005[1]
Co	0.0014	0.15	0.0014	0.0004	
Cu	0.0045	0.14	0.0045	0.0012	1.3[1]
Mn	0.029	9.6	0.028	0.0013	
Mo	**0.59**	0.004	**0.072**	0.037	0.05[2]
Ni	0.0079	0.032	0.0078	0.0018	
Pb	0.00013	0.0079	0.00013	< 0.00005	0.015[1]
Se-T	0.047	0.043	0.047	0.034	0.05[1]
U	0.012	0.16	0.012	0.010	
Zn	0.029	1.8	0.029	0.004	5[2]

[1] primary standard, IDAPA 58.01.11
[2] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

Reclamation of the WRSF would include a soil cap, revegetation, a sloped surface to divert water to the margins, and water diversion ditches along the margins, all of which would substantially reduce the amount of surface water currently infiltrating into the facility. Comparing the last column in Table 3.6-17 with the best estimate (Table 4.6-10) shows how the cutoff wall would remove mine-affected groundwater from the colluvium and reduce a major portion of the constituent load that currently reaches Thompson Creek. These analyses do not reflect the reduced infiltration that would occur when the cap is installed during reclamation.

Table 4.6-10. Loads in groundwater, Buckskin Creek watershed to Thompson Creek during mining.

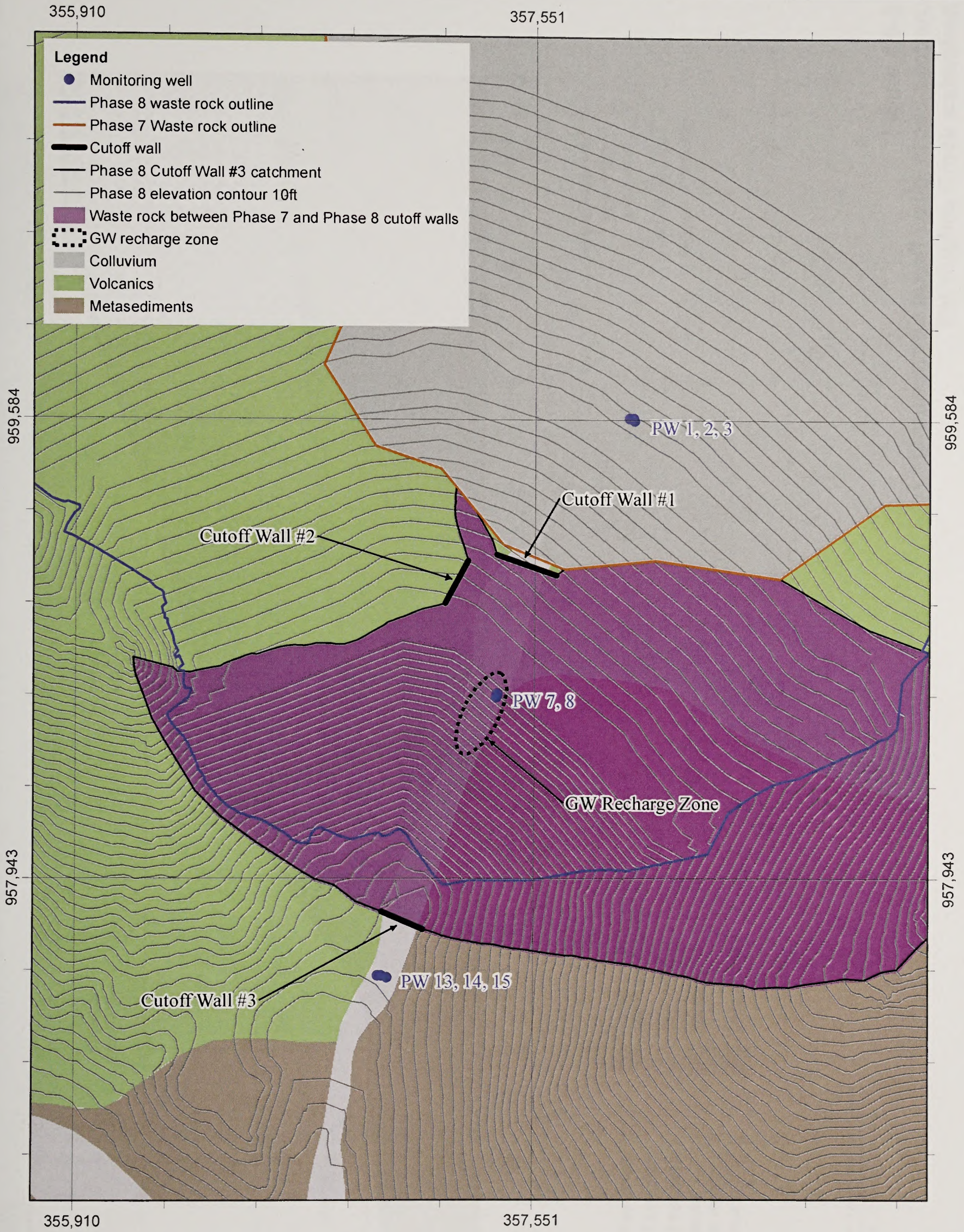
all units are pounds/day

Parameter	Current (2010)[1]	Alt. M1 with Cutoff Wall Best Estimate[2]	Alt. M1 with Cutoff Wall Upper Estimate[2]
SO_4^{2-}	146	2.76	6.45
Al	0.00036	0.00006	0.04422
As	0.00016	0.00015	0.00016
Cd	0.00006	$1.91x10^{-6}$	0.00005
Co	0.00008	$1.91x10^{-6}$	0.00031
Cu	0.00006	0.00002	0.00030
Fe	0.00057	0.00057	0.00080
Mn	0.00017	0.00013	0.01937
Mo	0.01636	0.00091	0.00090
Ni	0.00030	0.00001	0.00007
Pb	0.00001	$1.91x10^{-6}$	0.00002
Se-T	0.00509	0.00006	0.00015
U	0.00180	0.00030	0.00063
Zn	0.00130	0.00004	0.00366

[1] Wells BW2 (metasedimentary rocks) and BW4 (colluvium)
[2] BuckC

Pat Hughes Creek Watershed

The baseline groundwater conditions would continue, except for a reduction in constituents to Thompson Creek due to the installation of a groundwater cutoff wall (Cutoff Wall #1) downgradient of the Pat Hughes WRSF (Figure 4.6-4., Figure 4.6-5). Cutoff Wall #2 and Cutoff Wall #3 would capture seepage from waste rock only under Alternative M2 (Section 4.6.1.2.2). Cutoff Wall #1 would substantially reduce the amount of constituents in the seepage from the WRSF (PHtoe) (Table 4.6-11.) which would be delivered via groundwater to Thompson Creek. The cutoff wall would capture primarily water from the colluvium, which is more affected by seepage and of generally lower quality than water in the underlying metasedimentary rocks (Table 3.6-22). In other words, water getting past the cutoff wall would more closely resemble the quality of baseflow seepage than that from spring snowmelt (Table 4.6-11).



No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

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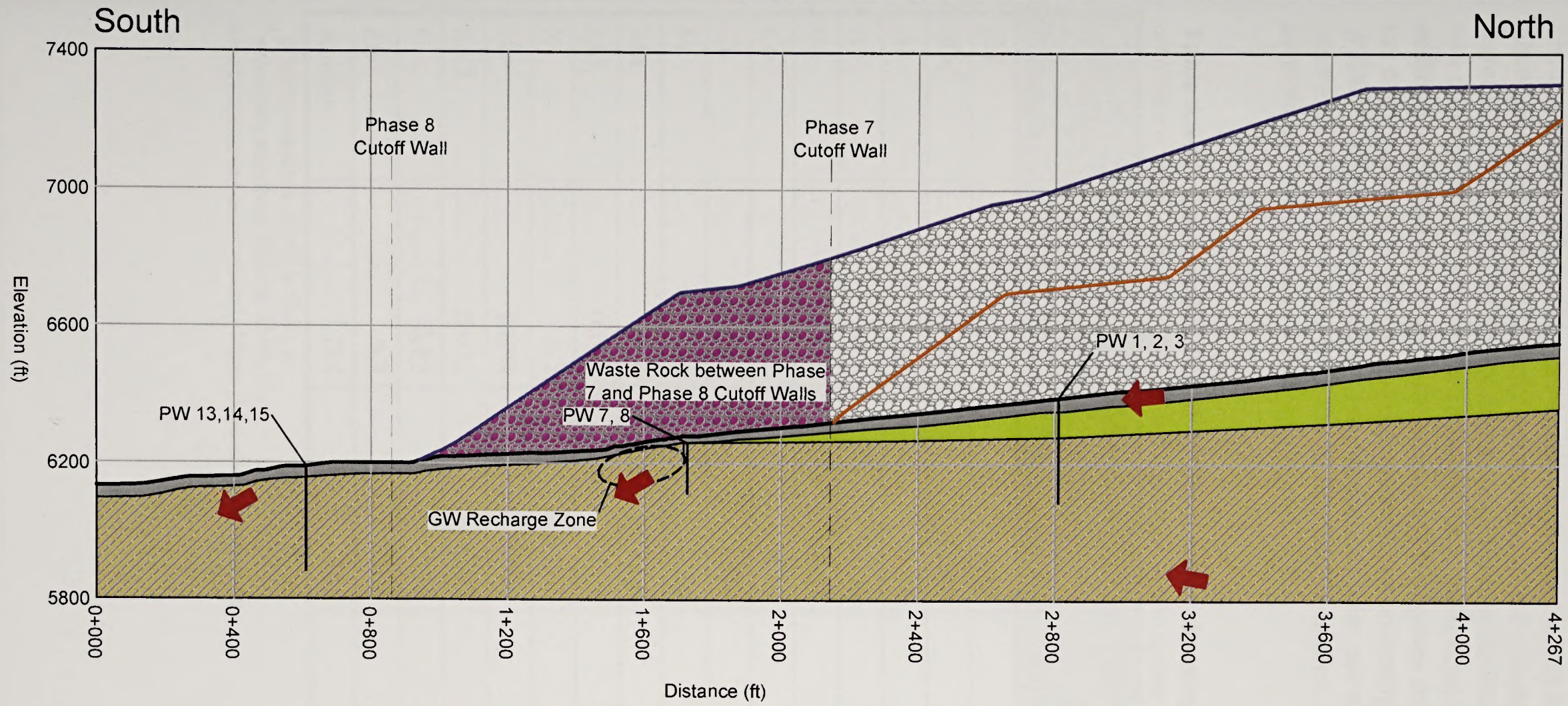
0 1:6,000 500

0 Feet 200

Meters

Data source JBR (2012g)

Figure 4.6-4
Groundwater cutoff walls,
Pat Hughes Creek watershed
Thompson Creek Mine EIS



LEGEND

- Original topography
- Phase 7 topography
- Phase 8 topography
- Groundwater recharge zone
- Flow direction
- Waste rock between Phase 7 and Phase 8 cutoff walls
- Waste rock
- Volcanics
- Metasediments

Vertical Exaggeration: 1X

Scale: 1:6000

Units: Feet

0 200 400

Source: JBR 2012g

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 4.6-5
Groundwater cutoff walls, cross-section,
Pat Hughes Creek watershed
Thompson Creek Mine EIS

The calculations of groundwater quality in the Pat Hughes Creek drainage that discharges to Thompson Creek are particularly conservative as the calculations used the chemistry of pore water (Table 4.6-11). In reality, the seepage leaving the Pat Hughes WRSF would be diluted by non-mine-affected groundwater recharged from areas outside the footprint of the WRSF. In addition, chemical reactions in the seepage as it migrates from the facility would further decrease the concentrations of chemicals compared to their concentrations in the pore water within the WRSF. Different concentrations of constituents were calculated for base flow and spring snowmelt because seepage from the facility has the highest concentrations of metals and other constituents during spring melt.

Table 4.6-11. Pat Hughes WRSF (PHtoe) water chemistry, Alternative M1.
all units are mg/L except s.u. for pH and mg/L $CaCO_3$ for acidity

Parameter	Maximum Pore Water Estimate	Alternative M1, Mining, Base flow	Alternative M1, Mining, Spring Snowmelt	Idaho Groundwater Standards
pH	**3.5**	**4.56**	**3.65**	6.5-8.5[2]
SO_4^{2-}	**2,460**	**1,540**	**2,220**	250[2]
Al	**93**	**54**	**83**	0.2[2]
As	**0.4**	0.004	0.017	0.05[1]
Cd	**0.110**	**0.055**	**0.081**	0.005[1]
Co	2.2	0.35	0.51	
Cu	**3.5**	0.41	**2.6**	1.3[1]
Fe	**1.4**	0.11	**0.57**	0.3[2]
Mn	**34.6**	**22.6**	**33.3**	0.05[2]
Mo	0.011	0.008	0.009	
Ni	0.1	0.061	0.09	
Pb	**0.094**	0.006	**0.063**	0.015[1]
Se-T	0.033	0.02	0.03	0.05[1]
U	0.82	0.36	0.53	
Zn	**9.3**	4.3	**6.3**	5[2]
Acidity	734	341	535	

[1] primary standard, IDAPA 58.01.11
[2] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

The water chemistry and constituent loading, respectively, to Thompson Creek from the Pat Hughes watershed were estimated following closure and reclamation (Table 4.6-12. and Table 4.6-13). The same closure methods that would be used at the Buckskin WRSF would be used at the Pat Hughes WRSF, including cutoff walls, a soil cap and revegetation on recontoured waste rock to reduce infiltration, grading to route overland flow away from the waste rock, and lined channels to route run-on from undisturbed areas of the watershed around the facility rather than through it. The cap for the Pat Hughes WRSF would be multi-layered and thicker than the one used at Buckskin to control infiltration to a greater degree than for the Buckskin facility. The constituent loads do not account for reduced infiltration after reclamation (Table 4.6-13).

Table 4.6-12. Pat Hughes Creek watershed water chemistry.
all units are µg/L except s.u. for pH and mg/L for SO_4^{2-}

	PW11[1] Metasedimentary Rock	Alternative M1 Leakage Around Cutoff Wall #1		Idaho Groundwater Standards
Parameter	Mean	Best Estimate	Upper Estimate	
pH	7.63	**4.6**	**3.5**	6.5-8.5[3]
SO_4^{2-}	245	**1,490**	**2,460**	250[3]
Al	27	**52,000**	**93,000**	200[3]
As	8.0	4.0	4.0	50[2]
Cd	0.04	**53**	**110**	5[2]
Co	1.15	340	2,200	
Cu	0.15	410	**3,500**	1,300[2]
Fe	110	110	**1,400**	300[5]
Pb	0.12	6.0	**94**	15[3]
Mn	**170**	**21,900**	**34,600**	50[3]
Mo	6.0	8.0	11	
Ni	2.0	59	100	
Se-T	1.0	19	33	50[2]
U	9.0	350	820	
Zn	22.0	4,100	**9,300**	5,000[3]

[1] mean measured concentrations in groundwater metasedimentary bedrock at PW11
[2] primary standard, IDAPA 58.01.11
[3] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

Water collected from the WRSF would not be discharged through NPDES Outfall 002; rather, this water would be pumped to a lime treatment plant where the pH of the water would be neutralized before the water would be added to the pit lake. Well PW11 (Table 4.6-12.) is based in metasedimentary rock to a medium depth and is the most downgradient well (closest to Thompson Creek); water quality in PW11 is believed to be the closest approximation to groundwater that reaches Thompson Creek. Leakage is based on estimated water quality that would go through or around the cutoff wall.

Loading (Table 4.6-13.) was calculated using the cross-sectional area of the aquifer, flow rate through the aquifer, and water quality. The total load to Thompson Creek is the sum of the amount of the constituents in the water in the metasedimentary rock and that in the water that leaks through and around the cutoff wall (Table 4.6-13).

Table 4.6-13. Loads in groundwater, Pat Hughes Creek watershed to Thompson Creek.
all units are pounds/day

Parameter	PW11[1] Meta-sedimentary Rock	Alternative M1 Best Estimate		Alternative M1 Upper Estimate	
	Mean	Cutoff Wall #1	Total Load	Cutoff Wall #1	Total Load
SO_4^{2-}	32.7	0.083	32.77	11.47	44.2
Al	$3.62x10^{-6}$	0.00290	0.00286	0.43339	0.43339
As	$1.07x10^{-6}$	$1.91x10^{-7}$	$1.91x10^{-6}$	0.00002	0.00002
Cd	$3.81x10^{-9}$	$3.05x10^{-6}$	$3.81x10^{-6}$	0.00051	0.00051
Co	$1.52x10^{-7}$	0.00002	0.00002	0.01025	0.01029
Cu	$1.91x10^{-8}$	0.00002	0.00002	0.01631	0.01638
Fe	0.00001	0.00001	0.00002	0.00653	0.00648
Pb	$1.52x10^{-8}$	$3.81x10^{-7}$	$3.81x10^{-7}$	0.00044	0.00044
Mn	0.00002	0.00122	0.00124	0.51968	0.16135
Mo	$8.00x10^{-7}$	$3.81x10^{-7}$	$1.91x10^{-6}$	0.00006	0.00006
Ni	$2.67x10^{-7}$	$3.24x10^{-6}$	$3.81x10^{-6}$	0.00046	0.00046
Se-T	$1.33x10^{-7}$	$1.14x10^{-6}$	$1.91x10^{-6}$	0.00015	0.00015
U	$1.14x10^{-6}$	0.00002	0.00002	0.00381	0.00383
Zn	$2.97x10^{-6}$	0.00023	0.00023	0.04343	0.04343

[1] mean measured concentrations in groundwater in metasedimentary bedrock at PW11

No Name Creek Watershed

There would not be any facilities or operations in the No Name Creek watershed, and there would be no effects to groundwater in the watershed during mining, reclamation, or post-reclamation.

Open Pit

The pit would be developed as previously described (e.g., Section 2.1.1.3., Section 2.1.1.8., Section 2.1.3.2) and the current water management would continue. After mining, the pit lake would develop (described as a surface feature, Section 4.6.1.1.1.) with an inward groundwater flow. As the pit lake develops, water from the deeper portion of the pit would begin to flow outward as groundwater, which would probably flow to the southwest into the Buckskin Creek watershed, but could find a pathway into the Pat Hughes Creek watersheds or into Thompson Creek (Section 4.6.1.2.2).

Bruno Creek Watershed

The amount of seepage from the TSF in the Bruno Creek watershed that reaches the Redbird Creek watershed would increase as the height of the impoundment rises which would increase the hydraulic head. The best estimate of the seepage quality is based on an estimated flow of 35 gpm and the median concentrations of the constituents measured in 2010. The upper estimate is based on a flow of 37.5 gpm and the maximum concentrations measured in 2010 (Table 4.6-14). The constituent loads to Redbird Creek would be relatively small (Table 4.6-15).

Table 4.6-14. Redbird Creek seepage quality.
all units are µg/L except mg/L for SO_4^{2-}

Parameter	Median 2010	Maximum 2010	Idaho Groundwater Standards
SO_4^{2-}	**1,230**	**1,360**	250[2]
Al	1	4.0	200[2]
As	2.5	6.5	50[1]
Cd	0.2	0.71	5[1]
Co	4.5	5.0	
Cu	0.1	5.0	1,300[1]
Fe	30	**5,920**	300[2]
Mn	**4,910**	**5,350**	50[2]
Mo	672	774	
Ni	12	13.9	
Pb	0.00005	0.000054	15[1]
Se-T	0.001	0.0011	50[1]
U	6	7.5	
Zn	5	15.0	5,000[2]

[1] primary standard, IDAPA 58.01.11
[2] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

Table 4.6-15. Loads in groundwater to Redbird Creek and S. Creek from the TSF.
all units are pounds/day

Parameter	Alternative M1 Best Estimate	Alternative M1 Upper Estimate
SO_4^{2-}	0.50940	0.54731
Al	0.00042	0.00168
As	0.00088	0.00202
Cd	0.00008	0.00009
Co	0.00198	0.00211
Cu	0.00004	0.00211
Fe	1.07366	1.60401
Mn	2.05245	2.11341
Mo	0.00042	0.00042
Ni	0.00505	0.00547
Pb	0.00002	0.00002
Se-T	0.00042	0.00042
U	0.00253	0.00295
Zn	0.00211	0.00589

After mining (no more tailings slurry to the TSF) much of the water in the impoundment would gradually drain from the TSF, and the surface of the impoundment would be sloped to drain precipitation from the impoundment. Both the impoundment and the embankment would have a soil cap with vegetation, but precipitation to the surface of the embankment would infiltrate into the embankment (less what is removed by evapotranspiration). Therefore, the ratio of the water draining from the impoundment (neutral pH currently and in the long-term) to the water draining from the embankment (neutral but may become acidic pH in the long-term) would decrease over time, i.e., the water draining from the TSF would be dominantly from the embankment and the water would probably become acidic with elevated concentrations of constituents in the long-term (Table 4.6-16). Note that molybdenum, which is most soluble at neutral pH, would have a higher concentration under current conditions, as opposed to that of all of the other metals.

To estimate the seepage quality from the TSF over the long term, the projected long-term water quality of seepage from the embankment was used since that will increasingly dominate seepage from the impoundment, which will decrease over time; this provides a conservative estimate of the long-term seepage water quality.

Table 4.6-16. TSF current and future drainage chemistry.
all units are mg/L except s.u. for pH and mg/L $CaCO_3$ for alkalinity and acidity

Parameter	Current Concentration	Predicted Maximum Concentration of Embankment Sands Seepage	Idaho Groundwater Standards
pH	6.9	**4.0**	6.5-8.5[2]
Alkalinity	130	--	
Acidity	--	145	
SO_4^{2-}	**1,250**	**1,915**	250[2]
Al	0.003	**16**	0.2[2]
As	0.0032	0.020	0.05[1]
Cd	0.0003	**0.3**	0.005[1]
Co	0.0048	0.44	
Cu	0.001	**1.9**	1.3[1]
Fe	0.03	**0.9**	0.3[2]
Mn	**4.9**	**25**	0.05[2]
Mo	0.690	0.001	
Ni	0.013	2.1	
Pb	0.00005	**0.1**	0.015[1]
Se-T	0.001	0.009	0.05[1]
Sr	7,400	20,000	
Zn	0.0076	**13**	5[2]

[1] primary standard, IDAPA 58.01.11
[2] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

The potential constituent loads to Bruno Creek from the TSF are from calculations of predicted long-term embankment seepage water quality multiplied by two flows. The best-estimate flow (3.9 gpm) was calculated from the saturated thickness of the colluvium below the SRD, its hydraulic conductivity, and the topographic gradient between MW1 and MW2. The best-estimate flow was doubled (8 gpm) for the upper estimate (Table 4.6-17).

Table 4.6-17. Loads in groundwater to Bruno Creek from TSF embankment seepage bypassing the SRD.

all units are pounds/day

Parameter	Alternative M1 Best Estimate	Alternative M1 Upper Estimate
SO_4^{2-}	0.09125	0.18250
Al	0.76200	1.52400
As	0.00095	0.00191
Cd	0.01429	0.02858
Co	0.02096	0.04191
Cu	0.09049	0.18098
Fe	0.04286	0.08573
Pb	0.00476	0.00953
Mn	1.19063	2.38125
Mo	0.00005	0.00010
Ni	0.10001	0.20003
Se-T	0.00044	0.00086
U	0.05239	0.10478
Zn	0.61913	1.23825

After reclamation, as the tailings consolidate and the saturation level declines (excluding the water trapped long-term in the sediments) in the TSF, the flow of groundwater from the TSF reaching the Redbird Creek watershed would decrease from 35 gpm to no flow, and the loads of sulfate and chloride would decrease proportionally.

Springs

The quantity and quality of the springs along Thompson Creek would not be meaningfully affected by the mine, i.e., even if the springs were recharged by bedrock groundwater flowing from the north (instead of the more probable recharge from Thompson Creek) the groundwater affected by mining is considered to be hydraulically isolated from the springs (in part due to strong upward hydraulic gradients and the presence of low permeability Challis volcanic rock).

There would probably be negligible effects to the quantity and quality of two springs in the Buckskin Creek watershed for which TCMC has water rights. That is, TCMC would continue to use the same amount of water from the springs, and the groundwater quality that is probably associated with the springs would not change. There would be no effects to springs in the No Name Creek watershed. Similarly, the springs in the Pat Hughes Creek watershed and in the unnamed watershed to the east would not be affected. There would be no changes to

groundwater flow in the Bruno Creek drainage. Therefore, there would be negligible effects to the quantity and quality of the springs in the Bruno Creek watershed.

4.6.1.2. Alternative M2 – MMPO as Submitted by TCMC

Surface Water

Water management would continue essentially unchanged from Alternative M1 (Figure 4.6-6., Figure 4.6-7., Figure 4.6-8). The differences in the effects between the two alternatives (summarized below) would be due to the increased areas of disturbance and the increased volumes of the pit, WRSFs, and TSF. The resultant chemistry of the pit lake also changes, compared to Alternative M1 (Table 4.6-5.), due to the changing ratios of contributing water (i.e., surface run-off from upgradient areas, groundwater inflow, direct precipitation, pit wall run-off, and treated WRSF water. However, as described below, the chemistry of the pit lake does not reflect what would be discharged at Outfall 005; with treatment, the quality of this water would be the same under both Alternative M1 and Alternative M2.

Thompson Creek and Tributaries

Low-flow Conditions

The Buckskin cutoff wall and two of the Pat Hughes cutoff walls (only one of which would be functional under Alternative M1) would remain in place and functional. A third cutoff wall would be installed in the Pat Hughes Creek watershed near the toe of the WRSF. For the Buckskin facility, the same quantity of colluvial groundwater would be captured as under Alternative M1. For the Pat Hughes facility, the additional cutoff walls would increase the amount of captured groundwater, thus reducing the flow to Thompson Creek by approximately 240 gpm on average (negligible effect). A small amount of shallow groundwater is estimated to pass through or around the cutoff walls in the Buckskin Creek and Pat Hughes Creek watersheds and deliver constituents to Thompson Creek. The difference in such loads from the Pat Hughes Creek watershed between the alternatives would be due to the increased footprint and volume of the Pat Hughes WRSF. The effect of the constituent loads on the water quality of Thompson Creek was assessed in the same manner as for Alternative M1 for both low flow (Table 4.6-18.) and the 7Q10 flow (Table 4.6-19).

Table 4.6-18. Thompson Creek water quality, low flow, Alternative M2.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Thompson Creek Receiving Water Quality	Predicted Thompson Creek Water Quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	14	20.2	23.5	N/A	N/A
Al	8.8	9.5	104.2	N/A	N/A
As	0.5	0.5	0.5	340	150
Cd	0.05	0.05	0.16	0.71	0.37
Co	0.1	0.11	2.32	N/A	N/A
Cu	0.8	0.82	4.34	8.4	6.0
Fe	30	30	32	N/A	N/A
Pb	0.075	0.08	0.17	28	1.1
Mn	0.48	0.8	112.9	N/A	N/A
Mo	2.07	2.5	2.6	N/A	N/A
Ni	0.46	0.5	0.6	247	27
Se-T	1.95	2.2	2.3	20	5
U	1	1.1	1.9	N/A	N/A
Zn	3	3.1	12.6	62	62

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 47 mg/L

Source	Description	Flow Estimates best	upper
a	Buckskin cutoff seepage - colluvium (gpm)	0.002	0.166
	Buckskin metasediment groundwater (gpm)	1.59	1.59
b	Pat Hughes cutoff seepage - colluvium (gpm)	0.027	1.94
	Pat Hughes metasediment groundwater (gpm)	11.1	11.1
c	Seepage via Redbird (gpm)*	45	45
d	Seepage via Bruno (gpm)**	3.9	8.0
e	Treated water (cfs) via outfall 005 after year 70	2.1	2.1

*only during early closure **only during late closure

Receiving stream **annual low flows,** *7q10*

Internal sources with no direct discharge

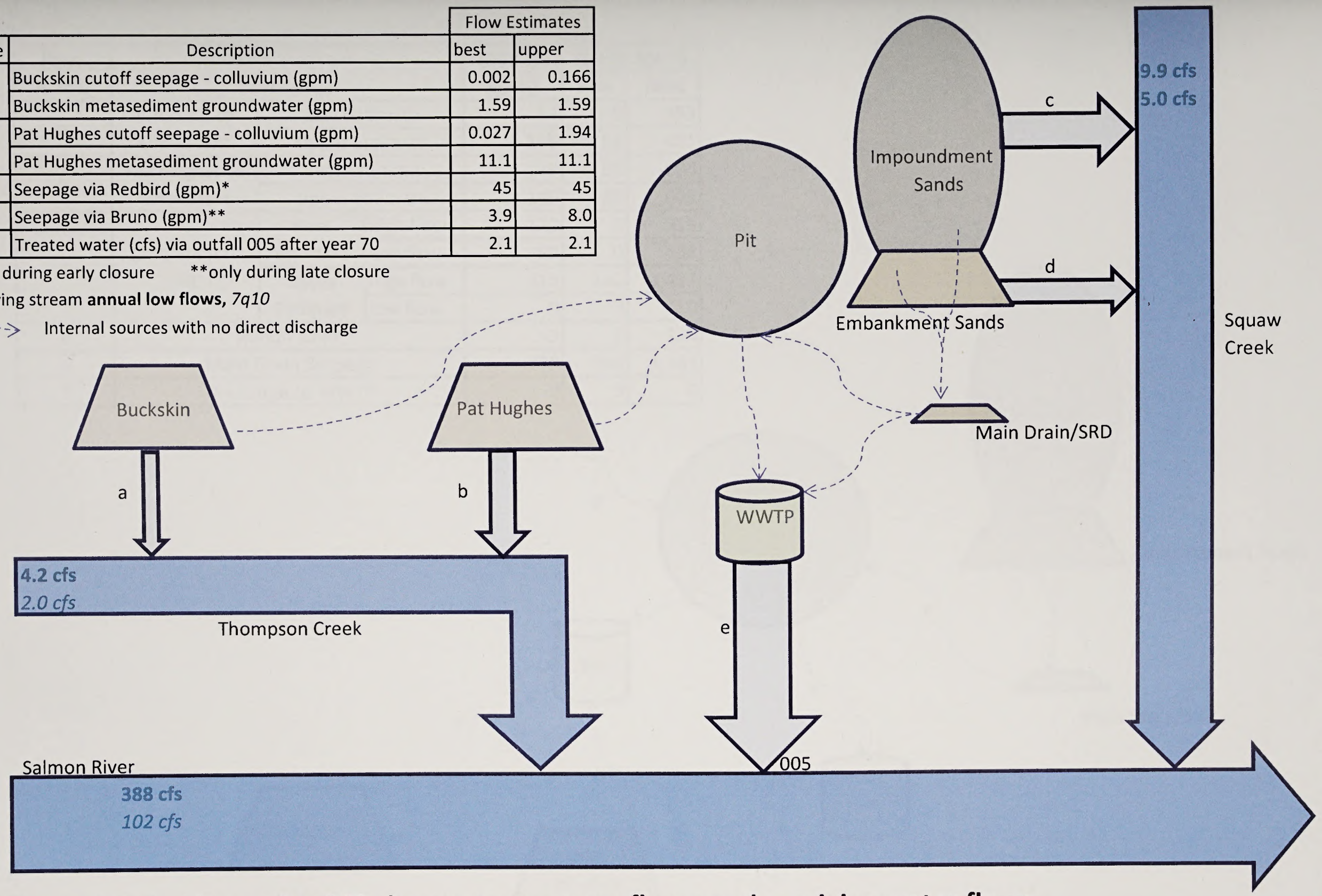


Figure 4.6-6. Alternative M2 closure source term fluxes and receiving water flows.

Flow Arrow	Description			Average (gpm)	Range (gpm) Min	Range (gpm) Max
a	Buckskin to Lime Plant	Best Estimate		53	0	359
		Upper Estimate		166	54	881
b	Pat Hughes to Lime Plant	Best Estimate		149	83	608
		Upper Estimate		149	83	608
c	Lime Plant to Pit	Best Estimate	high flow	123	0	513
			low flow	80	0	608
		Upper Estimate	high flow	315	142	1,417
			low flow	0	0	0
d	Runoff to Pit			13	3	120
e	Main Drain Seepage			739	456	1,385
f	Discharge to WWTP			0	0	0

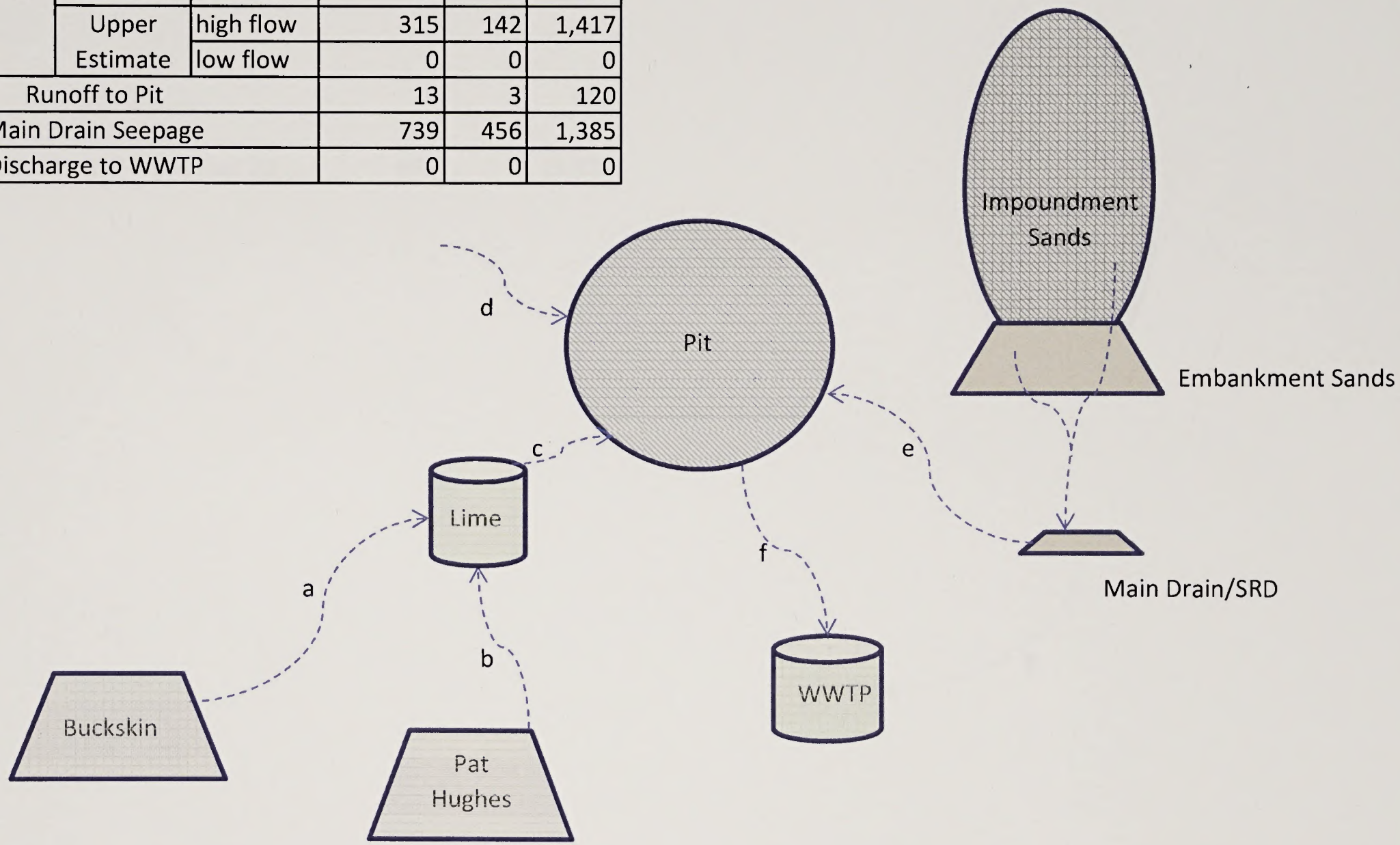


Figure 4.6-7. Alternative M2 water management, years 1-5.

Flow Arrow	Description			Average (gpm)	Range (gpm)	
					Min	Max
a	Buckskin to Lime Plant	Best Estimate		51	0	403
		Upper Estimate		219	45	1,497
b	Pat Hughes to Lime Plant	Best Estimate		239	70	1,579
		Upper Estimate		239	70	1,579
c	Lime Plant to Pit	Best Estimate	high flow	128	0	994
			low flow	150	0	1,579
		Upper Estimate	high flow	440	120	3,069
			low flow	0	0	0
d	Runoff to Pit			36	3	654
e	Main Drain Seepage			145	---	
f	Discharge to WWTP from Year 28			655	0	15,523

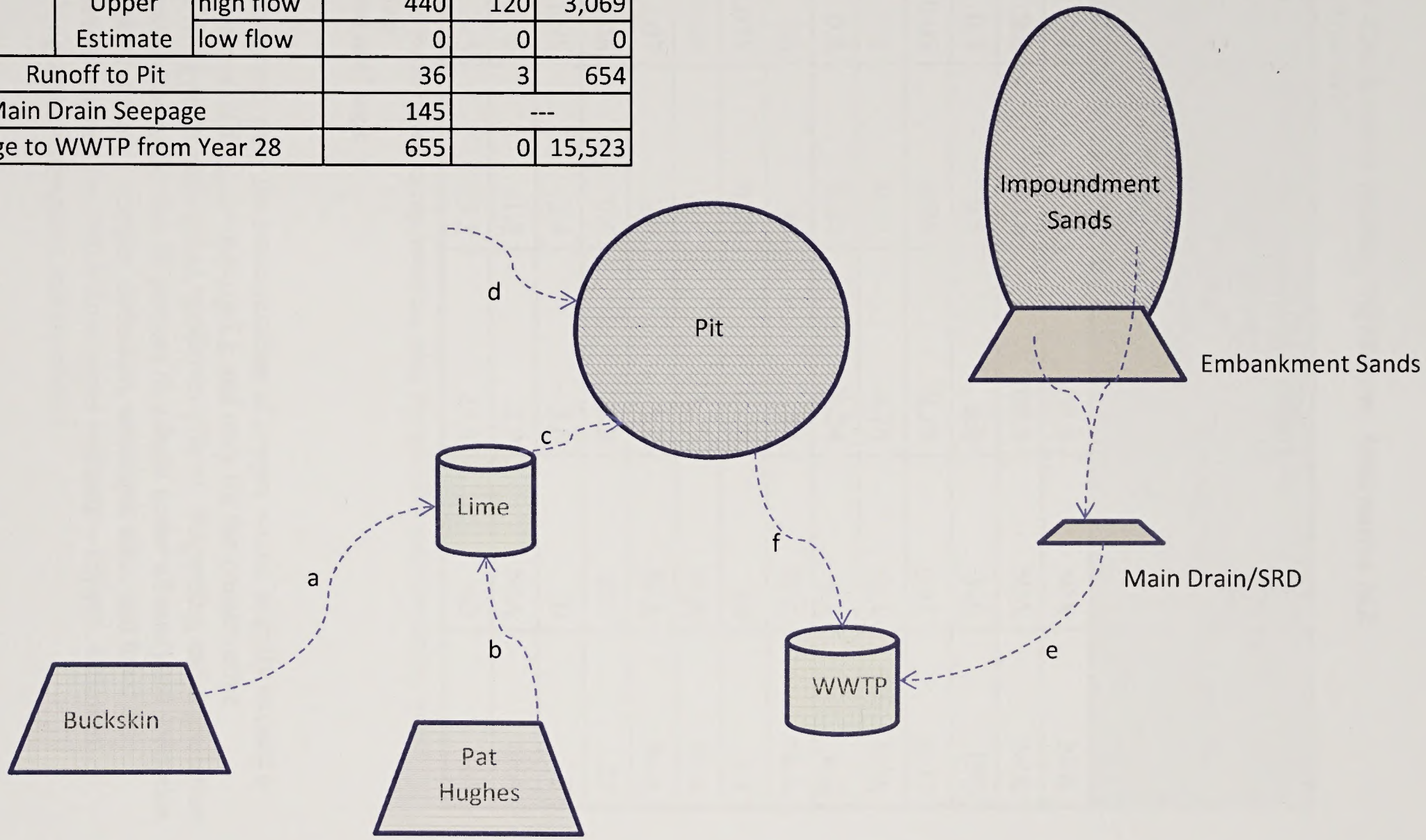


Figure 4.6-8 Alternative M2 water management, years 6-plus.

Table 4.6-19. Thompson Creek water quality, 7Q10 flow, Alternative M2.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Thompson Creek Receiving Water Quality	Predicted Thompson Creek Water Quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	14	27.0	33.8	N/A	N/A
Al	8.8	10.4	209.5	N/A	N/A
As	0.5	0.5	0.6	340	150
Cd	0.05	0.05	0.29	0.71	0.37
Co	0.1	0.11	4.76	N/A	N/A
Cu	0.8	0.84	8.24	8.4	6.0
Fe	30	30	34	N/A	N/A
Pb	0.075	0.08	0.28	28	1.1
Mn	0.48	1.1	236.9	N/A	N/A
Mo	2.07	2.9	3.1	N/A	N/A
Ni	0.46	0.5	0.8	247	27
Se-T	1.95	2.4	2.6	20	5
U	1	1.2	2.9	N/A	N/A
Zn	3	3.2	23.1	62	62

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC assuming a hardness of 47 mg/L

Of all of the constituents analyzed, only the concentration of copper would slightly exceed a numeric WQS (8.24 µg/L versus CCC_{copper} = 6.0 µg/L), and only for the conservative 7Q10 flow/upper estimate (long-term, infrequent, moderate effect). Regarding antidegradation, all evaluated constituents would be under the 10 percent threshold under all analyzed scenarios except for the low flow/upper estimate – copper, cadmium, selenium, zinc, and lead; the 7Q10 flow/best estimate selenium; and the 7Q10 flow/upper estimate – copper, cadmium, selenium, lead, and zinc (long-term, infrequent, minor effect).

High-flow Conditions

The water management structures would manage water for the same design storms that would be applicable under Alternative M1. The new culvert for the Phase 8 West road would manage at least a 500 year/24 hour storm during mining and reclamation, as would the relocated Pat Hughes sedimentation pond. Water management structures would manage design storms in the

same way and to the same extent as under M1. Therefore, there would be negligible effects to Thompson Creek from sediment delivery (i.e., TSS/turbidity) via Buckskin Creek or Pat Hughes Creek.

TCMC would manage mine-affected water throughout mining, reclamation, and post-reclamation such that the allowable discharges would meet the NPDES permit limits. Accordingly, Outfall 001 and Outfall 002 would continue to be used at times when the water quality from these outfalls would allow for discharge to Thompson Creek. Based upon the NPDES permit compliance history of the mine during the last 10 years, discharges would typically comply with all NPDES permit requirements. However, there could be occasional permit limit exceedances at these outfalls during spring run-off (long-term, negligible to minor effect). The pipeline installed in late 2011 in the lower Buckskin Creek watershed has resulted in improved water quality at the base of the Buckskin WRSF and to Thompson Creek and would be expected to make selenium exceedances at Outfall 001 less likely (the same situation as under Alternative M1) (long-term, minor effect).

S. Creek and Tributaries

Low-flow Conditions

Flow reductions to Bruno Creek would not be expected. However, there would be an increase in the base flow of Redbird Creek for Years 1 to 5 under Alternative M2 due to increased seepage from the higher TSF impoundment (up to ~ 45 gpm compared to ~ 35 gpm for Alternative M1 during mining) (long-term, minor effect on the base flow of either Redbird Creek or S. Creek). For Years 6-plus for both alternatives the seepage would diminish to no flow (no effect).

The water quality of S. Creek during mining would be essentially the same as for Alternative M1. The loads of sulfate and chloride to Redbird Creek from the TSF would continue to increase (by 28 %) during mining, but the effect to S. Creek would be negligible due to dilution of the seepage by both Redbird Creek and S. Creek. Any seepage that would bypass the Bruno Creek collection systems under Alternative M1, would continue only during mining under Alternative M2 (no or negligible effect).

During reclamation the same sources (i.e., impoundment tailings for Years 1 to 5 and embankment sands for Years 6-plus) with the same chemistry would contribute loads to S. Creek, similar to what would occur under Alternative M1. However, for Years 1 to 5 the loads would be 28 percent greater because of the increased flow to Redbird Creek due to increased heads in the TSF driving the seepage. Regardless, the greater loads would have negligible effects to S. Creek, i.e., no additional exceedances of numeric WQSs or antidegradation thresholds (Table 4.6-20. compared to Table 4.6-3.) (negligible effect). There would be no change to the water quality of S. Creek during Years 6-plus (i.e., Table 4.6-4.) except under the conservative 7Q10 flow/upper estimate for cadmium for which the concentration (1.11 ug/L) would be slightly greater than the CCC (0.74 ug/L) (long term, infrequent moderate or major effect).

Table 4.6-20. S. Creek water quality, Years 1-5, Alternative M2.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing S. Creek Receiving Water Quality	Predicted S. Creek Water Quality Low Flow		Predicted S. Creek Water Quality 7Q10 Flow		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate	Best Estimate	Upper Estimate		
SO_4^{2-}	75	88	89	100	102	N/A	N/A
Al	26	26	26	26	26	N/A	N/A
As	0.96	0.98	1.01	1.00	1.06	340	150
Cd	0.05	0.05	0.05	0.05	0.05	1.96	0.74
Co	0.14	0.19	0.19	0.23	0.24	N/A	N/A
Cu	0.53	0.53	0.58	0.53	0.63	26	16.7
Fe	30	56	69	81	107	N/A	N/A
Pb	0.1	0.10	0.10	0.10	0.10	105	4.1
Mn	2.5	52	53	100	103	N/A	N/A
Mo	2.8	2.8	2.8	2.8	2.8	N/A	N/A
Ni	1.3	1.5	1.5	1.6	1.6	686	76
Se-T	1	1.0	1.0	1.0	1.0	20	20/5
U	1	1.1	1.1	1.1	1.1	N/A	N/A
Zn	2.5	2.6	2.6	2.6	2.8	172	173

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 157 mg/L

High-flow Conditions

There would be negligible changes to flood flows/sediment delivery to Bruno Creek, Redbird Creek, or S. Creek.

Pit Lake and Salmon River

The water entering the open pit via precipitation, run-off, and groundwater pathways would continue to be pumped out (dewatered) and used during mining (up to 520 gpm compared to 358 gpm for Alternative M1). The additional water pumped from the pit would reduce the amount of make-up water withdrawn from the Salmon River (negligible effect). There would not be meaningful changes to streamflows in the locality during mining. However, during reclamation the pit would be used to store water collected by the water management system and water would no longer be withdrawn from the Salmon River. Both of these effects would occur under Alternative M1, but would occur 9 years later under Alternative M2. The larger pit (~ 1,000 feet wider and a floor elevation of 6,100 feet compared to 6,350 feet for Alternative M1) would require approximately 70 years after mining ceases to fill to the control level when discharge would begin, instead of approximately 30 years for Alternative M1 (same effect to the hydrologic balance as for Alternative M1, but for an even longer duration).

As with Alternative M1, water directed to the pit would be managed and treated as required to maintain neutral pH conditions in the facility. Although the same sources would contribute to the pit lake, their ratios would be different, such that the concentrations of the constituents in the lake would typically be 30 to 60 percent less than the concentrations for Alternative M1 (Table 4.6-5). Regardless, as with Alternative M1, once the surface of the pit lake reaches the control level, water would be pumped from the pit, treated, and discharged to the Salmon River at Outfall 005 along with other water from the SRD that would be pumped directly to the second treatment plant. The average discharge rate from Outfall 005 would be 945 gpm (2.11 cfs), compared to 914 gpm (2.04 cfs) for Alternative M1 (negligible effect for either low flow or high flow).

The quality of the water discharged from the pit lake via the second treatment plant would be the same as under Alternative M1 (Table 4.6-6). The water quality of the Salmon River downstream of S. Creek would be essentially the same as for Alternative M1 for both low flow (Table 4.6-21. versus Table 4.6-7.) and 7Q10 flow (Table 4.6-22. versus Table 4.6-8). The slight differences would be from the slightly greater discharge rate under Alternative M2 compared to under Alternative M1. However, all numeric WQSs for the Salmon River would be met (negligible effect). Regarding antidegradation, during the 7Q10 flow the concentrations of cadmium and selenium would exceed (or equal to in the case of selenium) the 10 percent threshold (same as Alternative M1).

Surface Water Rights

The BLM water rights to flows in Pat Hughes Creek would be more difficult to use for stockwatering as the Pat Hughes WRSF covers more of the downstream channel. However, such stockwater does not occur now and would not occur in the foreseeable future (negligible effect).

Table 4.6-21. Salmon River water quality, low flow, Alternative M2.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Salmon River Receiving Water Quality	Predicted Salmon River Water Quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	8.6	17.0	17.1	N/A	N/A
Al	10.6	23.4	24.8	N/A	N/A
As	1.57	1.6	1.6	340	150
Cd	0.050	0.06	0.07	0.9	0.43
Co	0.100	0.15	0.18	N/A	N/A
Cu	0.40	0.48	0.56	10.8	7.5
Fe	30.0	31.3	31.3	N/A	N/A
Pb	0.050	0.06	0.06	38	1.5
Mn	1.87	21.4	23.2	N/A	N/A
Mo	2.8	3.1	3.1	N/A	N/A
Ni	0.6	0.70	0.75	312	35
Se-T	1.0	1.2	1.2	20	5
U	2.0	2.2	2.2	N/A	N/A
Zn	3.7	4.2	4.6	78	79

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 62 mg/L

Table 4.6-22. Salmon River water quality,7Q10 flow, Alternative M2.
all units are µg/L except mg/L for SO_4^{2-}

Parameter[1]	Existing Salmon River Receiving Water Quality	Predicted Salmon River Water Quality		CMC[2]	CCC[2]
		Best Estimate	Upper Estimate		
SO_4^{2-}	8.6	36.5	36.8	N/A	N/A
Al	10.6	57.6	62.9	N/A	N/A
As	1.57	1.6	1.6	340	150
Cd	0.050	0.10	0.13	0.9	0.43
Co	0.100	0.28	0.41	N/A	N/A
Cu	0.40	0.65	0.95	10.8	7.5
Fe	30.0	32.7	32.9	N/A	N/A
Pb	0.050	0.07	0.08	38	1.5
Mn	1.87	75.5	82.2	N/A	N/A
Mo	2.8	3.6	3.6	N/A	N/A
Ni	0.6	0.90	1.09	312	35
Se-T	1.0	1.7	1.7	20	20/5
U	2.0	2.6	2.7	N/A	N/A
Zn	3.7	5.3	6.8	78	79

[1] Dissolved metal data were used for all metals except selenium, since the selenium guideline applies to the concentration of total selenium.
[2] CMC/CCC standards assuming a hardness of 62 mg/L

Groundwater

Buckskin Creek Watershed

The footprint of the upper Buckskin WRSF would be larger than under Alternative M1, which would change the ratio of precipitation which falls on and infiltrates the facility relative to the precipitation that falls on the entire watershed, i.e., there would be changes to the quality of the seepage from the facility. The change in volume of infiltration water at the surface water station BuckC, for an average year, would increase the amount of discharge from infiltration by 6 percent. The difference in constituent loads in groundwater to Thompson Creek between Alternative M1 and Alternative M2 would be negligible with the Buckskin Creek cutoff wall in place (Table 4.6-23. In addition to the increased footprint of the Buckskin WRSF, there would also be an increase in the amount of Type 2 (potentially acid-generating) waste rock in the facility. The best estimate assumes the waste rock in the Buckskin Creek WRSF would not become acid generating. The upper estimate assumes the waste rock in the facility would become acid generating, even though such is not expected in either the short-term or long-term.

Table 4.6-23. Loads in groundwater, Buckskin Creek watershed to Thompson Creek, after reclamation.

all units are pounds/day

Parameter	Current[1] Metased. Rock Mean	Alt. M1 Best Estimate	Alt. M1 Upper Estimate	Alt. M2 Best Estimate	Alt. M2 Upper Estimate
SO_4^{2-}	2.72	0.04	3.75	0.042	3.83
Al	0.00006	$5.72x10^{-8}$	0.04416	$5.72 x10^{-8}$	0.05829
As	0.00015	$1.91 x10^{-8}$	$7.62 x10^{-6}$	$1.91 x10^{-8}$	$8.00 x10^{-6}$
Cd	$1.91x10^{-6}$	$9.53 x10^{-9}$	0.00005	$1.14 x10^{-8}$	0.00006
Co	$1.91x10^{-6}$	$3.81 x10^{-8}$	0.00030	$4.00x10^{-8}$	0.00036
Cu	0.00002	$1.14 x10^{-7}$	0.00029	$1.35 x10^{-7}$	0.00030
Fe	0.00057	$7.24 x10^{-7}$	0.00023	$7.24 x10^{-7}$	0.00023
Mn	0.00013	$7.05 x10^{-7}$	0.01924	$8.38 x10^{-7}$	0.02400
Mo	0.00090	0.00001	0.00001	0.00002	0.00001
Ni	0.00001	$1.91 x10^{-7}$	0.00006	$2.29 x10^{-7}$	0.00008
Pb	$1.91x10^{-6}$	$3.81 x10^{-9}$	0.00002	$3.81 x10^{-9}$	0.00002
Se-T	0.00006	$1.12 x10^{-6}$	0.00010	$1.39 x10^{-6}$	0.00012
U	0.00030	$2.86 x10^{-7}$	0.00032	$3.62 x10^{-7}$	0.00040
Zn	0.00004	$7.05 x10^{-7}$	0.00362	$8.57 x10^{-7}$	0.00461

[1] BW2 Mean 2009-2010

Pat Hughes Creek Watershed

In addition to the two cutoff walls discussed previously (Section 4.6.1.1.), a third cutoff wall would be installed below the final toe of the facility. Cutoff Wall #3 would be anchored into competent metasedimentary rock below the higher groundwater recharge zone (where metasedimentary bedrock has greater than average conductivity for the formation). Therefore, only Type 1 (not acid-generating) waste rock would be placed in the space between Cutoff Wall #1 and Cutoff Wall #3 (Figure 4.6-4., Table 4.6-5). Furthermore, as for the Buckskin WRSF, the footprint and volume of the Pat Hughes WRSF would increase affecting the ratio between natural waters and mine-influenced waters. For example, due to the increased size of the facility there would be a larger amount of infiltration through the facility compared to under Alternative M1 and a lesser amount of groundwater from outside the influence of the WRSF. The chemistry of the seepage from the facility has been calculated for both base flow (Table 4.6-24.) and spring snowmelt (Table 4.6-25.) during both mining and reclamation with the cutoff walls in place for both Alternative M1 and Alternative M2.

Table 4.6-24. Pat Hughes WRSF baseflow water quality (PHtoe).
all units are mg/L except s.u. for pH and mg/L $CaCO_3$ for acidity

Parameter	Alt. M1 Mining	Alt. M1 Reclamation	Alt. M2 Mining	Alt. M2 Reclamation	Idaho Groundwater Standard
pH	**4.56**	**4.56**	**4.55**	**4.55**	6.5-8.5[2]
SO_4^{2-}	**1,540**	**1,490**	**1,730**	**1,690**	250[2]
Al	**54**	**52**	**63**	**61**	0.2[2]
As	0.004	0.004	0.004	0.004	0.05[1]
Cd	**0.055**	**0.053**	**0.062**	**0.061**	0.005[1]
Co	0.35	0.34	0.39	0.38	
Cu	0.41	0.41	0.42	0.42	1.3[1]
Fe	0.11	0.11	0.11	0.11	0.3[2]
Mn	**22.6**	**21.9**	**25.6**	**24.9**	0.05[2]
Mo	0.008	0.008	0.008	0.008	
Ni	0.061	0.059	0.069	0.067	
Pb	0.006	0.006	0.006	0.006	0.015[1]
Se-T	0.02	0.019	0.023	0.022	0.05[1]
U	0.36	0.35	0.41	0.40	
Zn	4.3	4.1	4.8	4.7	5[2]
Acidity	341	328	397	385	

[1] primary standard, IDAPA 58.01.11
[2] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

Table 4.6-25. Pat Hughes WRSF spring snowmelt water quality (PHtoe).
all units are mg/L except s.u. for pH and mg/L $CaCO_3$ for acidity

Parameter	Alt. M1 Mining	Alt. M1 Reclamation	Alt. M2 Mining	Alt. M2 Reclamation	Idaho Groundwater Standard
pH	**3.65**	**3.88**	**3.58**	**3.79**	6.5-8.5[2]
SO_4^{2-}	**2,220**	**2,050**	**2,300**	**2,108**	250[2]
Al	**83**	**77**	**86**	**79**	0.2[2]
As	0.017	0.011	0.02	0.013	0.05[1]
Cd	**0.081**	**0.075**	**0.084**	**0.077**	0.005[1]
Co	0.51	0.47	0.53	0.48	
Cu	**2.6**	**1.6**	**3.0**	**1.9**	1.3[1]
Fe	**0.57**	**0.36**	**0.67**	**0.42**	0.3[2]
Mn	**33.3**	**30.6**	**34.6**	**31.5**	0.05[2]
Mo	0.009	0.009	0.009	0.009	
Ni	0.09	0.083	0.093	0.085	
Pb	**0.063**	**0.035**	**0.076**	**0.044**	0.015[1]
Se-T	0.03	0.027	0.031	0.028	0.05[1]
U	0.53	0.49	0.55	0.50	
Zn	**6.3**	**5.8**	**6.5**	**6.0**	5[2]
Acidity	535	488	557	503	

[1] primary standard, IDAPA 58.01.11
[2] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

Pat Hughes Cutoff Wall #1 and Cutoff Wall #2 would be installed through colluvium and would be anchored in volcanic bedrock (distinct barrier to groundwater flow). Cutoff Wall #3 would be installed through colluvium and would be anchored in the metasedimentary rock (some affected groundwater would bypass the cutoff wall via the relative permeable metasedimentary rock under the wall). All of the constituents in groundwater from the Pat Hughes WRSF were conservatively assumed to reach Thompson Creek (no attenuation or reduction in loading along the groundwater flowpath).

Acidic seepage from the Pat Hughes WRSF mixes with groundwater before reporting as seepage to PHtoe. The ratio of Pat Hughes WRSF infiltration and groundwater seepage fluctuates throughout the year, with the greatest portion of flow being attributed to waste rock infiltration during the beginning of the spring snowmelt. Estimated Pat Hughes pore water (as opposed to PHtoe water which is diluted by groundwater flow) is used during spring melt time points to produce a conservative estimate of loadings (Table 4.6-26., Table 4.6-27).

Table 4.6-26. Pat Hughes WRSF discharge water quality, best estimate.
all units are µg/L except s.u. for pH and mg/L for SO_4^{2-}

Parameter	PW11[1] Metased. Rock	Alt. M1 Water Quality	Alt. M2 Water Quality			Idaho Groundwater Standards
		Cutoff Wall #1 Best Estimate	Cutoff Wall #1 Best Estimate	Cutoff Wall #2 Best Estimate	Cutoff Wall #3 Best Estimate[2]	
pH	7.63	**4.6**	**4.5**	**4.5**	8	6.5-8.5
SO_4^{2-}	245	**1,490**	**1,690**	**1,690**	**1,015**	250[4]
Al	27	**52,000**	**61,000**	**61,000**	1	200[4]
As	8.0	4.0	4.0	4.0	0.7	50[3]
Cd	0.04	**53**	**61**	**61**	0.15	5[3]
Co	1.15	340	380	380	0.4	
Cu	0.15	410	420	420	1.2	1,300[3]
Fe	110	110	110	110	30	300[4]
Pb	0.12	6.0	6.0	6.0	0.05	15[3]
Mn	**170**	**21,900**	**24,900**	**24,900**	1.1	50[4]
Mo	6.0	8.0	8.0	8.0	62	
Ni	2.0	59	67	67	0.8	
Se-T	1.0	19	22	22	34	50[3]
U	9.0	350	400	400	10	
Zn	22.0	4,100	4,700	4,700	5	5,000[4]

[1] mean measured concentrations in groundwater in metasedimentary bedrock at PW11
[2] median measured concentrations at BuckC 2009 to 2010
[3] primary standard, IDAPA 58.01.11
[4] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

Table 4.6-27. Pat Hughes WRSF discharge water quality, upper estimate.
all units are µg/L except s.u. for pH and mg/L for SO_4^{2-}

Parameter	Alt. M1 Water Quality Cutoff Wall #1 Upper Estimate	Alt. M2 Water Quality			Idaho Groundwater Standards
		Cutoff Wall #1 Upper Estimate	Cutoff Wall #2 Upper Estimate	Cutoff Wall #3 Upper Estimate[1]	
pH	**3.5**	**3.5**	**3.5**	7.6	6.5-8.5
SO_4^{2-}	**2,460**	**2,460**	**2,460**	**1,120**	250[3]
Al	**93,000**	**93,000**	**93,000**	2	200[3]
As	4.0	4.0	4.0	1.6	50[2]
Cd	**110**	**110**	**110**	0.37	5[2]
Co	2,200	2,200	2,200	0.9	
Cu	**3,500**	**3,500**	**3,500**	4.5	1,300[2]
Fe	**1,400**	**1,400**	**1,400**	40	300[3]
Pb	**94**	**94**	**94**	0.09	15[2]
Mn	**34,600**	**34,600**	**34,600**	9	50[3]
Mo	11	11	11	73	
Ni	100	100	100	7.8	
Se-T	33	33	33	44	50[2]
U	820	820	820	12	
Zn	**9,300**	**9,300**	**9,300**	14	5,000[3]

[1] minimum measured pH and maximum measured concentrations at BuckC during 2009 to 2010
[2] primary standard, IDAPA 58.01.11
[3] secondary standard, IDAPA 58.01.11
bold typeface indicates exceeds Idaho Groundwater Standard

The best estimate (Table 4.6-26.) is based on the estimated average seepage chemistry during baseflow conditions, and the upper estimate (Table 4.6-27.) is based on seepage comprised entirely of pore water with no groundwater dilution (e.g., pH 3.5). The concentrations in these tables represent the quality of the water that would be captured by each cutoff wall (i.e., upstream of the wall). The loads to Thompson Creek were also calculated using the flow that would pass through and around the cutoff walls (Table 4.6-28., Table 4.6-29).

Estimates of the constituent load to Thompson Creek from the Pat Hughes WRSF were calculated as the sum of loadings bypassing all three cutoff walls. The best estimates combined best estimate source chemistry as applicable to each cutoff wall with best estimates of leakage. The upper estimates combined maximum (upper limit) source chemistry with upper estimates of flow bypassing the cutoff walls (based on maximum measured hydraulic conductivity as applicable to each cutoff wall). There would be an order-of-magnitude increase in the total loads to Thompson Creek for most constituents compared to Alternative M1, with much of the increase occurring after reclamation because Cutoff Wall #3 would be anchored in metasedimentary rock rather than volcanic rock (long-term, minor effect). The total loads would be the sums of what would pass around or through the cutoff walls plus what reaches Thompson Creek via the metasedimentary rock.

Table 4.6-28. Loads in groundwater to Thompson Creek from the Pat Hughes watershed, best estimate.

all units are pounds/day

Param.	PW11 Metased. Rock Mean	Alt. M1 Water Quality		Alt. M2 Water Quality				
		Cutoff Wall #1	Total Load	Cutoff Wall #1	Cutoff Wall #2	Cutoff Wall #3	Metased. Rock	Total Load
SO_4^{2-}	32.67	0.08	32.77	0.09	0.36	0.06	135.45	135.83
Al	$3.62x10^{-6}$	0.00290	0.00286	0.00340	0.01311	$5.72x10^{-8}$	0.00013	0.01657
As	$1.07x10^{-6}$	$1.91x10^{-7}$	$1.91x10^{-6}$	$1.91x10^{-7}$	$9.53x10^{-7}$	$3.81x10^{-8}$	0.00010	0.00010
Cd	$3.81x10^{-9}$	$3.05x10^{-6}$	$3.81x10^{-6}$	$3.81x10^{-6}$	0.00001	$7.62x10^{-9}$	0.00002	0.00004
Co	$1.52x10^{-7}$	0.00002	0.00002	0.00002	0.00008	$1.91x10^{-8}$	0.00006	0.00015
Cu	$1.91x10^{-8}$	0.00002	0.00002	0.00002	0.00009	$5.72x10^{-8}$	0.00015	0.00027
Fe	0.00001	0.00001	0.00002	0.00001	0.00002	$1.91x10^{-6}$	0.00400	0.00400
Pb	$1.52x10^{-8}$	$3.81x10^{-7}$	$3.81x10^{-7}$	0.00	$1.91x10^{-6}$	$1.91x10^{-9}$	$7.62x10^{-6}$	$7.62x10^{-6}$
Mn	0.00002	0.00122	0.00124	0.00139	0.00535	$5.72x10^{-8}$	0.00015	0.00686
Mo	$8.00x10^{-7}$	$3.81x10^{-7}$	$1.91x10^{-6}$	0.00	$1.91x10^{-6}$	$3.81x10^{-6}$	0.00827	0.00819
Ni	$2.67x10^{-7}$	$3.24x10^{-6}$	$3.81x10^{-6}$	$3.81x10^{-6}$	0.00002	$3.81x10^{-8}$	0.00011	0.00013
Se-T	$1.33x10^{-7}$	$1.14x10^{-6}$	$1.91x10^{-6}$	$1.91x10^{-6}$	$3.81x10^{-6}$	$1.91x10^{-6}$	0.00453	0.00457
U	$1.14x10^{-6}$	0.00002	0.00002	0.00002	0.00009	$5.72x10^{-7}$	0.00133	0.00145
Zn	$2.97x10^{-6}$	0.00023	0.00023	0.00026	0.00101	$1.91x10^{-7}$	0.00067	0.00194

Table 4.6-29. Loads in groundwater to Thompson Creek from the Pat Hughes watershed, upper estimate.

all units are pounds/day

Parameter	PW11 Metased. Mean	Alt. M1		Alt. M2				
		Cutoff Wall #1	Total Load	Cutoff Wall #1	Cutoff Wall #2	Cutoff Wall #3	Metased.	Total Load
SO_4^{2-}	32.67	11.47	44.2	11.43	44.2	0.99	149.4	206
Al	$3.62x10^{-6}$	0.43339	0.43339	0.43339	1.66973	$1.71x10^{-6}$	0.00027	2.10350
As	$1.07x10^{-6}$	0.00002	0.00002	0.00002	0.00007	$1.33x10^{-6}$	0.00021	0.00030
Cd	$3.81x10^{-9}$	0.00051	0.00051	0.00051	0.00198	$3.81x10^{-7}$	0.00006	0.00253
Co	$1.52x10^{-7}$	0.01025	0.01029	0.01025	0.03943	$7.62x10^{-7}$	0.00011	0.04991
Cu	$1.91x10^{-8}$	0.01631	0.01638	0.01631	0.06287	$4.00x10^{-6}$	0.00061	0.07982
Fe	0.00001	0.00653	0.00648	0.00653	0.02515	0.00004	0.00533	0.03696
Pb	$1.52x10^{-8}$	0.00044	0.00044	0.00044	0.00171	$7.62x10^{-8}$	0.00002	0.00213
Mn	0.00002	0.51968	0.16135	0.16135	0.62122	0.00001	0.00120	0.78372
Mo	$8.00x10^{-7}$	0.00006	0.00006	0.00005	0.00019	0.00007	0.00973	0.01010
Ni	$2.67x10^{-7}$	0.00046	0.00046	0.00047	0.00171	$7.05x10^{-6}$	0.00105	0.00324
Se-T	$1.33x10^{-7}$	0.00015	0.00015	0.00015	0.00057	0.00004	0.00587	0.00667
U	$1.14x10^{-6}$	0.00381	0.00383	0.00382	0.01467	0.00001	0.00160	0.02019
Zn	$2.97x10^{-6}$	0.04343	0.04343	0.04334	0.16688	0.00001	0.00187	0.21222

No Name Creek Watershed

Under Alternative M2 there would be no new facilities or operations in the No Name Creek watershed. Therefore, there would be no effects to groundwater in the watershed.

Open Pit

The effects to groundwater related to the open pit would be the same as for Alternative M1, except more groundwater would be expected to flow away from the lower portions of the pit due to the greater hydraulic head (greater pit depth). Following flooding, the final water level of the flooded pit would be managed and maintained at the same elevation as for Alternative M1.

Bruno Creek Watershed

There would be no substantial changes to the operation of the TSF except the embankment height would increase 112 feet (7,640 feet to 7,752 feet), with a corresponding increase in seepage from the impoundment into Redbird Creek. The increased seepage would contribute slightly greater loads to Redbird Creek during operations (and hence to S. Creek) (Table 4.6-30., with data brought forward from Table 4.6-15.), but there would be negligible effects to S. Creek compared to Alternative M1 (and negligible effects under Alternative M1, Section 4.6.1.2.1).

The best estimate is based on the median measured concentrations, and the upper estimate is based on the maximum measured concentrations.

Table 4.6-30. Loads in groundwater to Redbird Creek and S. Creek from the TSF.
all units are pounds/day

Parameter	Alt. M1 Best Estimate[1]	Alt. M1 Upper Estimate	Alt. M2 Best Estimate[1]	Alt. M2 Upper Estimate
SO_4^{2-}	0.50940	0.54731	0.65456	0.70333
Al	0.00042	0.00168	0.00054	0.00216
As	0.00088	0.00202	0.00114	0.00260
Cd	0.00008	0.00009	0.00010	0.00012
Co	0.00198	0.00211	0.00254	0.00271
Cu	0.00004	0.00211	0.00005	0.00271
Fe	1.07366	1.60401	1.37960	2.06121
Pb	0.00002	0.00002	0.00003	0.00003
Mn	2.05245	2.11341	2.63747	2.71596
Mo	0.00042	0.00042	0.00054	0.00054
Ni	0.00505	0.00547	0.00649	0.00703
Se-T	0.00042	0.00042	0.00054	0.00054
U	0.00253	0.00295	0.00325	0.00379
Zn	0.00211	0.00589	0.00271	0.00757

[1] Best estimate is based on median measured concentrations and upper estimate is based on maximum measured concentrations.

The primary source of seepage water from the TSF would be the 10,000 gpm of tailings slurry, which would occur only during mining and would be the same for all MMPO alternatives. That is, unlike the WRSFs where the primary source of infiltration water would be precipitation, the slight increase in the footprint of the TSF would have negligible effect on seepage from the facility. The facility would be reclaimed in the same manner as for Alternative M1, with the same water management. Hence, the loads in groundwater to Bruno Creek from the embankment seepage bypassing the SRD would be the same except they would occur later than under Alternative M1 (Table 4.6-17). Water from the main drain would continue to be pumped to the pit or directly to the second treatment plant for treatment and discharge at Outfall 005 as required.

Springs

The two Pat Hughes springs would be covered by the expansion of the Pat Hughes WRSF (permanent, major effect to these water resources and BLM water rights).

4.6.1.3. Alternative M3 – No Name Waste Rock Storage Facility

Surface Water

There would be somewhat smaller footprints/volumes for the Buckskin and Pat Hughes WRSFs, but the effects to Thompson Creek from seepage from the Buckskin Creek and Pat Hughes Creek watersheds would generally be the same as under Alternative M2. All surface water in the No Name Creek watershed intercepted by the No Name WRSF would become part of the water management system. The water would probably be discharged to Thompson Creek at a new NPDES outfall at the base of the watershed during mining, but within a few decades after reclamation the water may need to be pumped to the pit for management and/or treatment before discharge to Outfall 005. Hence, the potential effects to Thompson Creek would be 1) reduced run-off from No Name Creek watershed; and 2) seepage from the No Name WRSF that could degrade shallow groundwater discharging to Thompson Creek. Using ratios of watershed areas and calculated flow reductions for the Buckskin Creek watershed and Pat Hughes Creek watershed, there would be a slightly greater decrease in the flow of Thompson Creek compared to Alternative M2 (negligible effect).

It is unknown to what extent drains, cutoff walls, or other mechanisms would capture seepage from a WRSF in the No Name Creek watershed. However, it would be reasonable to expect similar effects to groundwater quality as have occurred at the Buckskin and Pat Hughes WRSFs, which would cause additional effects to the water quality of Thompson Creek (long-term, minor to moderate effect).

Because the TSS data indicate that TCMC has been generally successful at controlling sediment delivery downstream of the existing WRSFs, it is reasonable to assume the same would occur for the No Name WRSF. Therefore, effects due to TSS would be the same as under Alternative M2, with a somewhat greater probability of exceedances of the NPDES permit limit for TSS (long-term, infrequent, minor effect).

Water Rights

The effects to water rights would be the same as for Alternative M2.

Groundwater

The groundwater in the No Name Creek watershed would remain pristine under Alternative M1 and Alternative M2, so any effects under Alternative M3 would represent the loss of a clean water input to Thompson Creek. The mixture and composition of the Type 1 and Type 2 waste rock that would be deposited in a No Name WRSF would determine the quality of the seepage from infiltration through the WRSF. However, based on the extensive observation and analysis of seepage from the Pat Hughes and Buckskin WRSFs, it is highly unlikely the seepage from the No Name WRSF would be pristine. If the seepage would be captured and treated, there would still be less pristine water input to Thompson Creek. Even if the seepage would meet NPDES standards and be discharged to Thompson Creek, the seepage would degrade water quality in Thompson Creek. Therefore, infiltration through a No Name WRSF would probably affect groundwater quality during mining and after reclamation (long-term, moderate effect).

Springs

It is unknown if there are any springs in the No Name Creek watershed, but any such springs would be covered by the No Name WRSF (permanent, major effect to BLM water rights if springs were present).

4.6.2. Land Disposal Alternatives

4.6.2.1. Alternative L1 – No Action

Once the offered lands were sold by TCMC, a new owner may develop or otherwise manage these lands in a way that water use or water quality could be altered, e.g., developing the property adjacent to the Salmon River into residential lots. Such development would have the potential to degrade surface water quality from disturbance of the land surface and groundwater quality from use of new septic systems. However, it is not possible to predict water quantity or quality changes resulting from land ownership changes, other than to assume compliance with all relevant regulations. In particular, it is assumed that water rights associated with the ranch would also be sold along with the land. It is further assumed that the new owner would put these water rights to similar beneficial use at similar quantities. If so, there would be no related change to water quantity. However, the condition of Lyon Creek would remain the same, e.g., there would be a dam/pond in lower Lyon Creek with relatively sparse riparian vegetation, a relatively large number of vehicle fords, little pool habitat, and distinct streambank erosion/sloughing.

4.6.2.2. Alternative L2 – Land Exchange Proposal

There would be negligible effects to water resources associated with the selected land, e.g., the Thompson Creek and S. Creek Conservation Easement would prevent any substantial disturbance along the Thompson Creek riparian corridor; there would be no subdivision/residential development along the S. Creek riparian corridor; and no effects to the S. Creek corridor are reasonably foreseeable (Figure 2.2-1). All of the irrigation and stockwatering water rights associated with the Broken Wing Ranch would be transferred to the US, but there would be no change to the volume or rate of flow for these water rights. The two parcels conveyed to Custer County would continue to be able to use groundwater for domestic purposes without a permit pursuant to 42 Idaho Statutes 111, 227.

Under the BLM management strategies, features such as a campground or boat launch could be constructed on the ranch. Sediment input to the Salmon River from these facilities would be minimal because of implementation of appropriate BMPs during construction, as well as appropriate control measures to minimize soil and bank erosion potentially caused by increased human use (negligible effect). Resting BWR-1 from grazing would reduce sediment input into the Salmon River (negligible effect).

The BLM would work to maintain more instream flow in Lyon Creek, but the amount of such flow is unknown. Under the Lyon Creek conceptual restoration plan, the Lyon Creek dam/pond would be removed, the vehicle fords would be consolidated, and the lower 1,850 feet of the channel would be restored to a more natural flow with less erosion/streambank sloughing (long-term, moderate effect). Adherence to standard sediment and erosion control BMPs would result in negligible effects from sediment and erosion during the restoration work. The irrigated

fields would typically be fertilized every few years and there would be no annual application of herbicides or insecticides to the fields, i.e., the Salmon River would not receive meaningful amounts of fertilizer (nitrate), herbicide, or insecticide run-off (negligible effect) (Redick, P. 2014). Spot herbicide treatments would occur (e.g., along roads) as necessary to comply with State laws and regulations, and would be in accordance with the BLM Challis Field Office integrated weed control program (BLM 2009a).

Under Alternative L2-B there would be no cattle using BWR-1 or the gated crossing of the Salmon River, which would reduce the amount of fecal coliform bacteria and sediment in Lyon Creek and the Salmon River (long-term minor effect for Lyon Creek, negligible effect for the Salmon River). Motorized use of the Lyon Creek ford (infrequent administrative access for BLM) would contribute negligible amounts of sediment to Lyon Creek. Motorized use of Lyon Creek Road (by the public) would not contribute any meaningful sediment to Lyon Creek. There would be no fertilizer run-off from the irrigated fields (negligible effect). All of the irrigated fields would be sprayed with herbicide in the first year of the vegetation conversion, and would receive aggressive spot herbicide applications during the next few years. In addition, other areas of the ranch (e.g., roads) would receive spot herbicide treatment. However, all such vegetation treatments would be in accordance with the BLM Challis Field Office integrated weed control program (negligible effects). The BLM would transfer the water rights associated with the ranch for irrigation (15.89 cfs) and stockwater (0.24 cfs) into a water bank for subsequent conservation, lease, or sale pursuant to State laws, the FLPMA, and approval by the IDWR (negligible effect). The lower portion of Lyon Creek would have an additional 6.22 cfs of flow during the growing season (long-term, moderate effect) (Section 3.6.2). There would not be any effect to water resources associated with the Garden Creek property.

4.6.2.3. Alternative L3 – Land Sale

The effects to water resources on the selected land would be the same as for Alternative L2. There would not be any effect to water resources on the offered lands.

4.6.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The effects to the selected land would be the same as under Alternative L2. Note that a shorter length (500 feet) of the S. Creek riparian corridor would leave Federal jurisdiction compared to Alternative L2 or Alternative L3 (2,500 feet) (Figure 2.2-1). However, the area of the S. Creek corridor leaving Federal jurisdiction could not be subdivided or residentially developed due to the Thompson Creek and S. Creek Conservation Easement, and no effects to the corridor are reasonably foreseeable. The effects to the offered lands would be the same as under Alternative L2, unless portions of the Broken Wing Ranch were removed to achieve equal valuation. Depending on the subparcels removed, not all of the RAC recommendations would be implemented and the effects to water quality on the Broken Wing Ranch would not occur. In the case of water quality, these changes were negligible, and therefore eliminating them would be a negligible effect. If the water rights associated with the Lyon Creek subparcel were eliminated from the transaction, there would be no effect on water quantity in Lyon Creek or the Salmon River.

4.6.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects would be the same as under Alternative L4, e.g., all of the S. Creek riparian corridor that would leave Federal jurisdiction would be subject to the conservation easement on the 1,500 acres and/or the Thompson Creek and S. Creek Conservation Easement.

4.7. Wildlife Resources

4.7.1. MMPO Alternatives

4.7.1.1. Alternative M1 – No Action

There would be no additional surface disturbance. Consequently, there would be no reduction or fragmentation of habitat for wildlife and special status terrestrial wildlife species, e.g., no effects to big game winter range, wildlife migration habitat/corridors, or any potential uptake of chemicals of potential concern by wildlife. There also would be no displacement of wildlife due to noise, and there would be no change to water quantity that would meaningfully affect wildlife (Section 4.6).

Regarding water quality, the predicted rare (late reclamation/7Q10 flow/upper estimate only), slight cadmium exceedance (1.11 µg/L versus $CCC_{cadmium}$ = 0.74 µg/L for a few days; no exceedance of the CMC) in S. Creek (Section 4.6.) would have a negligible effect on wildlife. This concentration would be below even the conservative concentration for long-term exposure to fish of 3 µg/L above which adverse effects could be either pronounced or probable. However, mammals and birds are comparatively resistant to the biocidal properties of cadmium (Eisler 1985a). Furthermore, the effects of cadmium to biological organisms is reduced by the presence of other metal ions such as zinc (Zn^{2+}), magnesium (Mn^{2+}), and chromium (Cr^{3+}) (e.g., Young 1991, ATSDR 2012). A more recent risk assessment study specific to mine-affected water including a pit lake determined the "no observed adverse effect level" (screening concentration) for chronic exposure for cadmium in water consumed by wildlife to be 4,130 µg/L for mammals and 6,230 µg/L for birds (Integral 2007, Table 4.7-1). These screening concentrations would be three orders of magnitude greater than the maximum concentrations of cadmium that would ever occur in S. Creek. The study is based on or supported by extensive scientific research including Eisler (e.g., 1985a, 1985b, 1988a, 1988b, 1993, 1998), the EPA (1993), and Sample et al. (1996).

Bioaccumulation of cadmium in aquatic life over time would be expected, e.g., wildlife ingesting certain aquatic plants or animals that preferentially uptake cadmium. However, the effects of cadmium bioaccumulation in wildlife would be negligible primarily because the screening concentrations (Integral 2007), which are orders of magnitude above the predicted concentrations of cadmium in S. Creek, include the potential effects of bioaccumulation. In addition, no studies are known that evaluated cadmium bioaccumulation from drinking water with concentrations of cadmium less than 20 µg/L (which is far greater than what might occur in S. Creek).

After reclamation, as the pit lake develops, there would be new migratory bird habitat created by the accumulating water in the pit. Raptors, songbirds, or waterfowl traveling within a few miles of the lake would be expected to use the lake at least occasionally for resting or foraging since there are few lakes in the area. Overall, migratory bird populations using the mine site may

increase due to the additional surface water habitat. The regular use and colonization of the lake and surrounding habitats by birds would depend on the physical characteristics of the lake that would develop over decades (e.g., depth of "shore," lake turnover); the quality and quantity of vegetation that would emerge around the pit margin; and the diversity of colonizing macroinvertebrate organisms (long-term, minor effect, i.e., effects to individuals and not populations).

The pit lake would have high concentrations of several metals relative to natural water bodies (Table 4.6-5). However, all of the concentrations of constituents of potential concern (metals) in the lake would be at least two orders of magnitude below the screening concentrations for wildlife drinking the pit lake water (Integral 2007).

Table 4.7-1. Pit lake water chemistry compared to screening concentrations.
all units are µg/L

Parameter	Alt. M1	Alt. M2	Birds	Mammals
As	5.2	3.5	22,000	290
Cd	12	8.5	6,230	4,130
Cu (III/IV)	160	99	202,000	65,000
Fe	390	290	--[1]	--[1]
Mn	7,300	5,500	4,284,000	377,000
Mo	400	250	15,000	600
Ni	19	13	333,000	171,000
Pb	10	7.4	4,860	34,000
Se-T	20	20	2,150	860
Zn	730	450	62,000	685,000

[1] No screening concentrations were established for iron as iron is not typically found in water in concentrations that are a concern to birds or mammals (Integral 2007).

The most sensitive species (e.g., macroinvertebrate organisms living within the water) would be affected by the pit lake water. However, a direct relationship between the effects to aquatic macroinvertebrate organisms and birds would be improbable. Bioaccumulation of metals in birds via ingestion of lower organisms in the pit would be improbable because these organisms (e.g., macroinvertebrate organisms and plants) would not be expected to occur at or in the pit at levels that would be attractive to birds, and thus birds would not be expected to use the pit for foraging. Therefore, there would be no effects to wildlife (birds or mammals) from the pit lake, even from bioaccumulation. There would also be no effects to wildlife from ingesting soil as none of the soil at the mine would contain elevated concentrations of metals due to mining activity, i.e., greater than the BLM risk management criteria (the concentrations at which further study may be warranted) which for cadmium is 15,000 µg/kg for cattle, 3,000 µg/kg for mule deer, and 300 µg/kg for robins (BLM 2004).

Wildlife would be expected to drink occasionally from the collection facilities for drainage from the WRSFs and the TSF, as there are no structures to prevent wildlife access in these areas. Water sources for wildlife are available along Thompson Creek, along S. Creek, at Twin Apex Creek (less than one mile south of the SRD), and at Upper Bruno Creek at the north end of the TSF, so wildlife would not be expected to use the WRSFs, TSF, or SRD ponds regularly for drinking water due to a lack of other water sources. Although water in the WRSFs, TSF, and SRD will be acidic with elevated concentrations of constituents over the long-term (e.g., Table 4.6-16) none of the maximum concentrations exceed the screening concentrations for birds or mammals listed in Table 4.7-1 (which, as stated previously, include factors for bioaccumulation; Integral 2007). Therefore, even regular use of the WRSFs, TSF, and SRD collection ponds for drinking water would not result in adverse effects to wildlife over the long term.

The main noise sources at the mine that could affect wildlife would continue to be from equipment operation, traffic, and human presence (Section 3.10., Section 4.10). Most wildlife would continue to avoid noise, but some individuals would remain, or return, and become habituated to noise. Mule deer, for example, have habituated to noise at the mine; they would continue to be common even adjacent to the main access road or taking shelter under stationary heavy equipment that is not being operated.

Biological surveys would continue to be conducted during the nesting season in areas planned for disturbance to identify any active nests for bird species. Avoidance plans would be developed as necessary to prevent nest abandonments as a result of noise and human presence in the disturbed areas. Some residual, direct effects to migratory birds may occur if disturbance of these areas is necessary during the nesting season. Should any nests occur in the analysis area, they would likely be abandoned due to noise (short-term, minor effects). However, unintentional take is not expected, and if it occurs, would not have any meaningful effect on populations of migratory birds. Douglas-fir and sagebrush scrub habitats planned for disturbance are generally prevalent across the landscape, and only a miniscule amount of riparian habitat would be affected under any of the MMPO alternatives.

The same amounts and patterns of traffic would occur during mining and reclamation for all of the MMPO alternatives, except the duration of the effects would be approximately 10 years longer for Alternative M2 and Alternative M3. An (indirect) effect of all of the MMPO alternatives would be wildlife injured or killed by TCMC traffic, primarily on SH 75 between the S. Creek Bridge and US Highway 93. An estimated 25 to 50 deer, several elk and bighorn sheep, approximately 100 smaller mammals such as coyotes and rabbits, and a few hundred birds are estimated to be killed each year by all collisions with vehicles on this section of SH 75 (Zwetzig 2012). Mine-related traffic (mostly between 5:00 am and 7:00 am and 5:00 pm and 7:00 pm during shift changes) would comprise approximately 40 percent of the traffic on this section of SH 75 (Section 3.16.) and much of the mine-related traffic would occur during twilight/peak periods for animal movement. Mine-related traffic would also comprise approximately 10 percent of the traffic on US Highway 93 between Challis and the junction of SH 75 with US Highway 93, and an even smaller percentage of the traffic on US Highway 93 between Challis and Salmon (Section 3.16). Therefore, the mine-related traffic would continue to cause proportional wildlife mortality on US Highway 93.

4.7.1.2. Alternative M2 – MMPO as Submitted by TCMC

Timber would be harvested and the understory would be gradually removed (buried by the WRSFs or inundated by the TSF). Therefore, the effects to wildlife from decreased forest habitat would occur at the beginning of mining, whereas the effects to wildlife from decreased understory habitat would occur gradually during mining (over ~ 10 years). Fragmentation of habitat would not increase for any wildlife species because the mine disturbance would be extensions of current disturbance, i.e., currently usable habitat adjacent to the mine would be reduced in size but no new discontinuities or isolation of patches in the habitat would be created (negligible effect). The effects from habitat disturbance to special status terrestrial wildlife species are described below (Table 4.7-2.) followed by the effects to general wildlife.

Table 4.7-2. Effects to special status terrestrial wildlife species.

Species	Occurrence in MMPO area	Effects
MAMMALS		
Canada lynx	**Possible** (movement only)	There would be less (391 acres) forested habitat that lynx could use for moving through the analysis area. The habitat for lynx would be marginal because it would be adjacent to the mine. After reclamation there would be mostly open, shrub-dominated habitat in the disturbed areas, which is not preferred lynx habitat. However, the decrease and modification to lynx habitat would not result in a meaningful change to the movement patterns of any lynx that may move through or near the analysis area (negligible effect).
Gray wolf	**Likely** (movement, temporary cover, and foraging)	There would be less (458 acres) habitat that could be used by gray wolves for foraging as well as movement, temporary cover, or temporary denning. After reclamation there would be mostly open, shrub-dominated habitat in the disturbed areas, which would be suitable for foraging if prey are present. The disturbed habitat would be adjacent to the mine, so there would not be any substantial modifications to the movement areas or foraging opportunities in the analysis area for gray wolves. Habitat for gray wolf exists in the S. Creek and Thompson Creek watersheds adjacent to the disturbance that would occur. These habitats could be used in place of the disturbed habitats. Effects to gray wolf would be on the scale of a few individuals that may occur near the mine. Wolf packs would not be affected by this decrease and the modification of habitat (long-term, minor effect).

Species	Occurrence in MMPO area	Effects
American pika	**Present** (observed in WRSFs)	Pikas were observed in the analysis area at lower elevations than the species usually occurs (> 8,000 feet) in the WRSFs. Pika habitat created by the WRSFs would increase slightly during mining (~ 10 years), after which reclamation would render the habitat unsuitable for pikas. Rock habitat for pikas, in the form of WRSFs, would decrease over the long term. The lower Buckskin WRSF, where one pika was observed, would not be covered until the end of mining (long-term, moderate effect). It is possible that reclamation targets for rocky slope habitat (which would include moderate to steep rock or talus slopes with varying boulder sizes vegetated with grasses, legumes, and low shrubs) would provide some habitat for pikas. Such reclaimed habitat would be available in the long term.
Bighorn sheep	**Possible** (movement, temporary cover, and foraging)	There would be less (458 acres) habitat for bighorn sheep. The disturbed area is not known winter or summer habitat used by bighorn sheep. The potential habitat would be adjacent to the mine. Any bighorn sheep that are known to utilize this habitat could instead utilize adjacent habitat. Some bighorn sheep would also be expected to habituate to mining disturbances. Effects to bighorn sheep from decreases in habitat and possible displacement would be on the level of a few individuals that may utilize the analysis area or move through the area in the future (long-term, minor effect).
Fisher	**Possible** (movement and foraging)	There would be less (391 acres) forested habitat for fishers in the long term, as reclamation would cause a more open, shrub-dominated habitat in most areas, which would be unsuitable for fishers. Because the disturbed habitat would be adjacent to the mine, the decrease and modification of the habitat would reduce the available area for fishers to hunt and forage (as opposed to denning). These effects would be on the scale of individuals (long-term, minor effect).
Spotted bat	**Possible** (roosting and foraging)	There would be a small decrease (< 0.01 acre) in riparian habitat that could be used by spotted bats for foraging. No potential roosting sites (rock outcrops) for spotted bats would be disturbed. The decrease in foraging area would have a negligible effect on spotted bats, as only a few individuals may be affected.

Species	Occurrence in MMPO area	Effects
Pygmy rabbit	**Possible** (in microhabitat patches)	There would be less (62 acres) sagebrush habitat as a result of the expansion. However, areas of disturbance are not likely to contain microhabitat patches suitable for pygmy rabbit as soils in these areas are too rocky. The sagebrush areas most likely to contain microhabitat patches for pygmy rabbit (eastern part of the S. Creek watershed) would not be disturbed (negligible effect).
Townsend's big-eared bat	**Possible** (roosting and foraging)	There would be a small decrease (< 0.01 acre) in riparian habitat that could be used by Townsend's big-eared bats for foraging. No potential roosting or hibernacula sites for Townsend's big-eared bats (rock outcrops, caves, or abandoned mines) would be disturbed. The decrease in the riparian foraging habitat would have a negligible effect on Townsend's big-eared bats, as only a few individuals may be affected.
Wolverine	**Possible** (movement only)	There would be less (458 acres) mostly forested habitat that could be used by wolverines for movement, temporary cover, and foraging. Disturbed areas would probably not be used for denning due to their proximity to the mine. The decrease in habitat would not substantially modify any movement or foraging opportunities for wolverines. If any individuals currently utilize the habitat that would be disturbed, the individual would instead use adjacent habitat that would not be undisturbed. After reclamation the habitat would be largely unsuitable for wolverines due to its openness and proximity to the mine. The potential displacement of wolverines and decrease of habitat would be on the scale of individuals that may utilize the area near the mine for foraging or movement. Overall, wolverine populations would not be affected because wolverines utilize large home ranges and avoid human disturbances in general (long-term, minor effect).
BIRDS		
Greater sage-grouse	**Unlikely**	There would be less (62 acres) sagebrush habitat as a result of the expansion. However, this habitat is not likely to be occupied by sage-grouse and no individuals would be directly affected. There would be no indirect effects from habitat loss because the disturbance area is not considered important sage-grouse habitat according to the latest science-based and interagency collaboration (BLM 2012c) (negligible effect).

Species	Occurrence in MMPO area	Effects
Bald eagle	**Possible** (foraging only)	There would be less (458 acres) potential foraging area for bald eagles. No potential roosting trees along water bodies or creeks would be disturbed. The decrease in the foraging habitat would not be meaningful to bald eagle individuals and thus would have a negligible effect on bald eagles that may be migrating through the area or roosting along the Salmon River or S. Creek. A bald eagle nest occurs next to S. Creek Road which is used by mine-related (and other) traffic. The nest was first recorded in 2009 and was active; therefore, the bald eagles that established and occupy the nest were accepting of the traffic on S. Creek Road. There would be no change to the amounts or patterns of the traffic, but the mine-related traffic would occur for approximately 10 years more (negligible effect).
Boreal owl	**Possible** (nesting and foraging)	There would be less (391 acres) forested habitat for boreal owl nesting and foraging. After reclamation there would be a more open, shrub-dominated habitat in most areas, possibly with scattered conifer trees, which would not be suitable foraging habitat for boreal owls. Because the areas to be disturbed would be close to the mine, it is improbable the disturbed habitat is being used for nesting. Thus, the decrease and modification of habitat would result in a reduction of potential foraging habitat that would affect boreal owl individuals that may be nesting outside of the analysis area (long-term, minor effect).
Brewer's sparrow	**Possible** (nesting)	There would be less (62 acres) sagebrush habitat suitable for nesting brewer's sparrows. In the long term the reclaimed areas would resemble the open, shrub-dominated or grassland habitats that were suitable for nesting brewer's sparrows (negligible effect).
Calliope hummingbird	**Possible** (nesting)	There would be less (391 acres) forested habitat for calliope hummingbird nesting. After reclamation there would be more open, shrub-dominated habitat in most areas at the mine, eventually with scattered conifer trees. Some new forest edge habitat would provide suitable nesting habitat for calliope hummingbirds. The decrease and modification of nesting habitat would be on the scale of individual hummingbirds that may use the analysis area (long-term, minor effect).

Species	Occurrence in MMPO area	Effects
Flammulated owl	**Likely** (nesting and foraging)	There would be less (391 acres) forested habitat for flammulated owl nesting and foraging. After reclamation there would be more open, shrub-dominated habitat in most areas, some of which may be suitable foraging habitat for flammulated owls. It is unlikely that the forest habitat to be disturbed contains dense enough stands for nesting; therefore, disturbance would only reduce potential foraging habitat for flammulated owls (long-term, minor effect).
Great gray owl	**Possible** (nesting and foraging)	There would be less (391 acres) forested habitat for great gray owl nesting, and there would be less (5 acres) grassland that may provide foraging habitat. After reclamation there would be more open, shrub-dominated habitat in most areas, possibly with scattered conifer trees, which could be suitable foraging habitat for great gray owls. The decrease and modification of forested habitat would affect any great gray owl individuals that may be nesting in the vicinity of the analysis area (long-term, minor effect).
Hammond's flycatcher	**Possible** (nesting)	There would be less (391 acres) forested habitat for Hammond's flycatchers. After reclamation there would be more open, shrub-dominated habitat in most areas, which would no longer be suitable nesting habitat for this species. The decrease in nesting habitat would affect only individuals that may use the analysis area (long-term, minor effect).
Northern goshawk	**Possible** (nesting and foraging)	There would be less (391 acres) forested habitat for goshawk nesting and foraging. After reclamation there would be more open, shrub-dominated habitat in most areas, possibly with scattered conifer trees, which would no longer be suitable for nesting. The decrease and modification of forested habitat would affect any goshawk individuals that may be nesting in the vicinity of the analysis area and would not affect goshawk populations (long-term, minor effect).
Olive-sided flycatcher	**Possible** (nesting)	There would be less (391 acres) forested habitat for olive-sided flycatchers. After reclamation there would be more open, shrub-dominated habitat in most areas, which would not be suitable nesting habitat. The decrease in nesting habitat would affect only the few individuals expected to use the area (long-term, minor effect).

Species	Occurrence in MMPO area	Effects
Peregrine falcon	**Possible** (foraging only)	There would be less (458 acres) potential foraging area for peregrine falcons. No potential nesting sites would be disturbed. There would be negligible effects to individual peregrine falcons that may migrate through the area or nest along the Salmon River.
Pileated woodpecker	**Possible** (nesting)	There would be less (391 acres) forested habitat for pileated woodpeckers. Any pileated woodpeckers in the disturbed areas would be displaced. The decrease of habitat and potential displacement would affect only the few individuals expected to use the area (long-term, minor effect).
Three-toed woodpecker	**Possible** (nesting)	There would be less (391 acres) forested habitat for three-toed woodpeckers. Any individuals in the disturbed areas would be displaced. The decrease in habitat and potential displacement would affect only the few individuals expected to use the area (long-term, minor effect).
Willow flycatcher	**Possible** (nesting)	There would be a small decrease (< 0.01 acre) in riparian habitat. The decrease would not meaningfully affect any individuals.
Williamson's sapsucker	**Possible** (nesting)	There would be less (391 acres) forested habitat for Williamson's sapsuckers. Any individuals in the disturbed areas would be displaced. The decrease in habitat and potential displacement would affect only the few individuals expected to use the area (long-term, minor effect).
REPTILES AMPHIBIANS		
Columbia spotted frog	**Possible**	There would be a small decrease (< 0.01 acre) in riparian habitat. The decrease in potential habitat would not affect any Columbia spotted frogs that may use the aquatic habitats in the analysis area.

General Wildlife

There would be less (458 acres, mostly forested) general wildlife habitat available for movement, temporary cover, denning, and foraging. However, the habitat would be adjacent to the mine so there would probably not be any essential movement areas in the habitat, or any substantial modifications to wildlife movement in the analysis area. Species such as small mammals and game animals that currently utilize undisturbed habitat adjacent to the mine would continue to utilize such habitat. In the short term (1-10 years) and the long-term (> 10 years) there would be less conifer forest available for temporary cover and denning, but after reclamation there would be open, shrub-dominated habitats available for foraging and movement areas. In the long term much of the mine (except the open pit) would be conifer forest habitat. Considering the amount of habitat available for general wildlife in the analysis area, there may be a small, detectable effect to individuals from the decrease and modification of habitat, as individuals who use these areas would be displaced into adjacent habitat. There would be no effects to the population viability of any wide-ranging species (long-term, minor effect).

All of the habitats that would be disturbed would be potentially used for migration by big game (deer, elk, and possibly bighorn sheep). However, there would be no major migration corridors in the disturbed areas. In addition, the habitat to be removed would be adjacent to the mine and there would be abundant undisturbed (and eventually reclaimed) habitat, e.g., there would be migration routes around obstacles such as the open pit or the steep faces of the WRSFs. Therefore, there would not be substantial modifications to migration patterns in the analysis area (negligible effect).

There would be less (391 acres) suitable habitat for forest species in the short term and long term. Considering the amount of habitat for forest species in the analysis area, the displacement of forest species into adjacent suitable habitats would affect some individuals that may use the area but would not have a detectable effect on the viability of any population (long-term, minor effect).

There would be less (62 acres) sagebrush habitat and less (5 acres) grassland during mining, but after reclamation most of the disturbed area would be open, shrub-dominated or grassland habitats, and eventually conifer forest. These habitats would be available as foraging habitat for raptors and nesting habitat for other migratory bird species. Reclamation targets for mule deer and elk winter range would be to provide flat to moderately sloping areas with a mix of grasses, forbs, shrubs, and conifer trees in patches which would provide suitable habitat for migratory birds. Grassland/shrub habitat is very common in the analysis area, thus there would be much undisturbed grassland/shrub habitat adjacent to or near the mine. Only some individuals that may use the disturbed areas would be affected, and the gradual nature of the disturbance to the understory would provide opportunity for these individuals to move if necessary and avoid direct effects (short-term, minor effect).

The amount of aspen riparian habitat is declining in the BLM Challis Field Office area, and the structural diversity of many riparian habitats in general is declining due to decreases in shrubs, trees, and herbaceous species that maintain function. However, there would be only a small decrease (< 0.01 acre) in the riparian habitat (negligible effect).

A total of 496.6 acres would be disturbed (including developed or barren areas with no vegetation), with 57 percent of the disturbed area in mule deer winter range and 69 percent in elk winter range. There would be no crucial winter range in the MMPO area. After reclamation the same area of winter range for mule deer and elk would be available. There would be no change to population numbers or growth rate due to the decrease in winter range habitat and capability. Mule deer and elk are very common and visible in disturbed areas of the mine, and regularly use the modified habitat and tolerate proximal human activity. Therefore, there would not be effects at the population level. In addition, there would be adequate winter range habitat available in areas adjacent to the mine, which would not require substantial modification of movements or behavior for mule deer or elk to access (long-term, minor effect).

Unintentional, incidental take of migratory birds during habitat removal may occur. Timber harvest, power line relocation, and pipeline construction would be the most likely activities to result in a minor amount of unintentional take. Most new disturbance would occur adjacent to existing disturbance and would occur gradually. Avoidance measures would be implemented as part of environmental controls (Section 2.1.1.7.) to avoid affecting nesting birds. Unintentional take, occurring when active nests are either not found during surveys (i.e., disturbed unintentionally), or cannot be avoided, would be a short-term, minor effect and would not have any measurable effects on migratory bird populations. The habitats that would be disturbed (sagebrush scrub and Douglas-fir forest) are abundant in the surrounding areas. This gradual mode of disturbance would allow any birds present to leave the area and avoid direct effects.

Other

In general there would be the same effects to wildlife from water quality, noise, and chemicals of potential concern (long-term, negligible to minor effects). The magnitudes and durations of these effects would not change due to their timing, i.e., mining would continue for approximately 10 years more compared to Alternative M1, and the pit lake would require approximately 70 years instead of 30 years to reach the control level (but a small lake would be present within a year or two after the end of mining). There would be a slightly lower concentration of metals in the pit lake (Table 4.7-1.) (negligible effect).

4.7.1.3. Alternative M3 – No Name Waste Rock Storage Facility

There would be greater disturbance (32 %) compared to under Alternative M2, with 234 acres of new disturbance in the No Name Creek drainage. Habitat in the drainage would be sloped, sometimes steeply, and covered with sagebrush, scattered rocky outcrops, and isolated conifer trees. The habitat would probably be foraging habitat for raptors and nesting habitat for other migratory bird species. General wildlife (wide-ranging species) would not be expected in the drainage since the upstream end of the canyon would be blocked by steep walls and would contain the mine operations.

The effects would be to individuals and not local populations. Any raptors that use the No Name Creek drainage as foraging habitat would forage elsewhere, and there would be adequate similar (undisturbed) habitat in the analysis area such that raptors would not be displaced from the analysis area. In addition, the affected habitat would not be of high value due to the proximity of

the mine. Migratory birds may be displaced into adjacent habitat for nesting; however, there is adequate similar habitat in the analysis area (long-term, minor effects).

There would be less wildlife habitat disturbance in the Buckskin Creek drainage (~ 50 acres) and Pat Hughes Creek drainage (~ 30 acres) compared to under Alternative M2. Relative to Alternative M2, the undisturbed portions of the Buckskin Creek drainage would be mostly steep hillsides with relatively open forest and grassy understory, which would provide some habitat for migratory birds adjacent to the existing mine. The undisturbed portions of the Pat Hughes Creek drainage would consist of mainly conifer forest, which may provide foraging habitat for raptors and nesting habitat for other forest-dependent species. However, the undisturbed patch would be surrounded by WRSFs and may not be suitable for wildlife (negligible effect).

A total of 639.8 acres would be disturbed, with 69 percent of the area in mule deer winter range and 67 percent in elk winter range. The disturbance would cause the same overall effect compared to Alternative M1 (long-term and minor) as would Alternative M2.

4.7.2. Land Disposal Alternatives

4.7.2.1. Alternative L1 – No Action

There would be no changes to the current conditions for wildlife and special status terrestrial wildlife species for the selected or offered lands.

4.7.2.2. Alternative L2 – Land Exchange Proposal

There would be no effects to special status terrestrial wildlife species, or other wildlife, including big game for the selected land (apart from mining, Section 4.7.1). By better managing grazing in the riparian area along the Salmon River, the riparian area would support a greater density of riparian vegetation. This would be an improvement to the habitat for riparian and other migratory bird species, as well as big game (mule deer, elk, and bighorn sheep) at the ranch, especially for wildlife at BWR-1 (long-term, minor effects). The addition of 813 acres of PGH and PPH for sage-grouse within all of the ranch (Section 3.7.4; see BLM 2012b for definitions) would increase the amount of PGH and PPH (combined) in the BLM Challis Field Office by 0.1 percent (negligible effect).

Under Alternative L2-B the shrubland habitat that would develop at the ranch would be an increase in wildlife habitat in the BLM Challis Field Office area (BLM 1998) (long-term, minor effects). Not grazing the area would lead to full expression of native vegetation, yielding more cover for ground-nesting birds, pygmy rabbit, and possibly sage-grouse. Studies in the southwestern deserts show that not grazing (as under Alternative L2-B) compared to moderate grazing (as under Alternative L2), leads to lower diversity of wildlife such as rabbits, quail, dove, songbird, and raptors (Holechek 1991). Not grazing the area may lead to both positive and negative effects to greater sage-grouse brooding habitat (Beck and Mitchell 2000, Evans 1986). There would be no wolf predation on livestock (or controlled wolf kills in response), but wolf predation has not been an issue at the ranch to date (negligible effect). Big game would be able to utilize the natural forage which would provide more forage than irrigated fields used for grazing (long-term, minor effect). Wildlife would be displaced more often and further from the upper Lyon Creek Road due to vehicle noise (Section 4.10.2.2.) (long-term, minor effect).

There would be no effects to special status species, or other wildlife, including big game for the Garden Creek property, unless the property would have been developed under Alternative L1. In such case there would be a small amount (2 acres/~ 2 %) of additional wildlife habitat and less noise (negligible effects).

The selected land would contain more wildlife habitat (in acres) than the offered lands. However, the habitat at the selected land would generally be of common quality; typically, riparian areas, such as those found on the ranch, have higher diversity and value as wildlife habitat. The selected land would not contain any critical habitat areas or occupied habitat for any special status terrestrial wildlife species except possibly the flammulated owl in the S. Creek drainage (a flammulated owl was recorded north of the selected land). Nearly all of the selected land would be winter range for mule deer and elk (Table 4.7-3.), which would not be disturbed or modified (apart from mining, Section 4.7.1). Although pika were observed at the WRSFs, there would be no pika habitat outside of the MMPO area. Habitats at the selected land (Table 4.7-3.) may provide suitable habitat for other special status terrestrial wildlife species, including potential movement, foraging, or temporary roosting areas (negligible effects). There would be no meaningful changes in hunting pressure at the selected land; TCMC would allow non-motorized access to the only two areas of the land that occasionally have been used in the past by hunters, but would continue to not allow hunting by TCMC employees or the public on TCMC land.

The offered lands would contain much less habitat than the selected land (Table 4.7-3). However, in terms of habitat scarceness and suitability for special status terrestrial wildlife species, the offered lands would contain more suitable habitat, which would be more likely to be occupied in the future by special status terrestrial wildlife species than the habitats at the selected land. For example, the Broken Wing Ranch along the Salmon River is a scarce habitat. In addition, species such as sage-grouse, willow flycatcher, calliope hummingbird, or Brewer's sparrow may use the riparian or adjacent meadow/shrub habitat along Lyon Creek. Pygmy rabbits are likely to occur within toe slopes above the agricultural fields. Bald eagles roost along the river during winter. All of the ranch would be crucial winter range for mule deer and also would contain some winter range for elk and bighorn sheep. On the Garden Creek property, Townsend's big-eared bats were observed and would probably use the riparian or open areas for foraging. The habitat on portions of the ranch would be improved under BLM management, such as better managing grazing in riparian areas. These improvements would affect any big game animals, migratory birds, special status, or riparian species that use the local area on and around the ranch (long-term, minor effects).

There would be increased hunting pressure on the ranch (birds, waterfowl, and big game) and in the Lyon Creek drainage (long-term, minor effect to wildlife). Hunting has probably been limited on the Garden Creek property in the past, and there would be no meaningful increase in hunting on the property.

Table 4.7-3. Big game habitat types, Alternative L2.

Habitat	Selected Land	Offered Lands	
		Broken Wing Ranch	Garden Creek Property
Sagebrush	1,225	260	0
Riparian	71	32	1
Conifer Forest	3,356	0	79
Mule deer crucial winter range	0	803	0
Mule deer winter range	4,836	32	0
Elk winter range	5,073	81	0
Bighorn winter range	0	124	0

4.7.2.3. Alternative L3 – Land Sale

The effects to terrestrial wildlife and special status species at the selected land would be the same as under Alternative L2. There would not be any effects to wildlife (e.g., habitat improvement or increased hunting pressure) from BLM administration of the ranch (long-term, negligible to minor effects); the effects to the offered land would be the same as under Alternative L1. In addition, if the land was sold to a party other than TCMC, non-motorized access to the selected land might not be guaranteed (negligible effect due to the scarce public use of the selected land).

4.7.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

Less area (1,500 acres) of value to special status terrestrial wildlife species (especially the S. Creek drainage and densely forested areas south of Bruno Creek Road) would be acquired by TCMC compared to under Alternative L2. However, TCMC would not disturb or alter wildlife habitat on the selected land (apart from mining, Section 4.7.1.) (no difference in effect compared to Alternative L2).

Regarding the offered lands, the ranch contains potential habitat for special status terrestrial wildlife species. Specifically BWR-1, BWR-2, and BWR-3 along Lyon Creek contain meadow/shrub habitat adjacent to riparian areas for sensitive bird species, including sage-grouse. In addition, BWR-1 would be managed as big game winter range, and all of the subparcels contain crucial winter range for mule deer (Table 4.7-4). There would be no effect to wildlife if any of the subparcels were not acquired by the US because the value of the lands to wildlife would not change. If the Garden Creek property were eliminated from the land exchange, there would not be any meaningful changes to special status terrestrial wildlife species in the short term. If the property were developed over the long term there would be a reduction in the available habitat for these species.

Table 4.7-4. Big game habitat types, Alternative L4.

Habitat	Selected Land	Offered Lands							
		BWR-1	BWR-2	BWR-3	BWR-4	BWR-5	BWR-6	BWR-7	GC[1]
Sagebrush	928	108	6	3	5	49	57	32	0
Riparian	25	0	0	4	9	0	4	5	1
Conifer forest	2,217	0	0	0	0	0	0	0	79
Mule deer crucial winter range	0	151	110	39	143	98	209	54	0
Mule deer winter range	3,384	32	0	0	0	0	0	0	0
Elk winter range	3,530	81	0	0	0	0	0	0	0
Bighorn winter range	0	124	0	0	0	0	0	0	0

[1] Garden Creek property

4.7.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

There would be no effects to wildlife or special status species on the selected land compared to Alternative L2 and Alternative L4. There would be no effects to wildlife or special status species if the ranch subparcels were not acquired by the US. As under Alternative L4, if the US were to not acquire the Garden Creek property there would be no effect to special status species.

4.8. Fish and Aquatic Resources

4.8.1. MMPO Alternatives

4.8.1.1. Alternative M1 – No Action

The 1980 EIS for the TCM (USFS 1980) describes the effects of the mine on aquatic habitat. In short, Buckskin Creek, No Name Creek, and Pat Hughes Creek did not have substantial fish populations, but might produce some organisms that could drift to Thompson Creek and be eaten by fish. There would be a distinct decrease in the aquatic resources of Buckskin Creek, No Name Creek, and Pat Hughes Creek, but no effects to fish populations in Thompson Creek. The TSF in the Bruno Creek drainage would cause longer periods of no/low streamflow in Bruno Creek downstream of the facility, which would decrease the amount of aquatic habitat and result in the loss of fish populations in Bruno Creek. The TSF would not generate substantial changes

in the water quality or hydrology of S. Creek or the Salmon River. Despite erosion and sediment controls, there would be some effects from sediment to spawning and rearing habitat in streams near the mine. Prior to the mine, all or nearly all of the streamflow in S. Creek downstream of Bruno Creek was diverted for agricultural uses. To mitigate the effects to Bruno Creek, TCMC committed to attempting to restore S. Creek as a viable anadromous fishery by acquiring and managing water rights in the creek to sustain a minimal year-round streamflow. Since then, mining has affected aquatic habitat, primarily in the Buckskin Creek, Pat Hughes Creek, and Bruno Creek drainages (Section 3.8). Effects to aquatic habitat and fish populations in Thompson Creek, S. Creek, and the Salmon River have been minimized through water management. However, decreased streamflow, changes in water quality, and minor effects to habitat due to adjacent roads have occurred.

Under Alternative M1 there would be no additional disturbance in the Thompson Creek and S. Creek drainages, and there would be no change to the length of intermittent and perennial streams affected. However, the effects to aquatic habitat and fisheries resources that may occur during mining from changes to current water quantity and quality (predicted changes and methodology are discussed in detail in Section 4.6.1.1.) would be the following:

- Negligible reductions (1 %) in Thompson Creek streamflow due to installation of cutoff walls and sedimentation pond linings in the Buckskin Creek and Pat Hughes Creek drainages to intercept shallow groundwater seepage flows that bypass the NPDES outfalls in these drainages and reach Thompson Creek.
- Decreased concentrations of many constituents in Thompson Creek (other than those listed below) for both the best and upper estimates due to installation of the cutoff walls.
- Increased concentrations of some constituents in Thompson Creek over time (even with the cutoff walls) due to degradation of the residual seepage. The concentrations of copper and lead would be predicted to increase above the current concentrations for the best estimate for both the low flow and 7Q10 flow. The concentrations of aluminum, cobalt, copper, lead, manganese, uranium, and zinc would be predicted to increase above the current concentrations for the upper estimate for low flow. The concentrations of aluminum, cadmium, cobalt, copper, lead, manganese, uranium, and zinc would be predicted to increase above the current concentrations for the upper estimate for the 7Q10 flow. The concentrations of iron would be similar or slightly greater than the current concentration for all scenarios. The concentrations of all constituents in Thompson Creek would meet all WQSs;
- Slightly increased flow in S. Creek (< 0.01 cfs) due to increased seepage from the TSF to Redbird Creek; and
- Water quality in S. Creek would be predicted to remain the same as the current condition, i.e., seepage from the TSF to Redbird Creek would not be expected to affect the water quality of S. Creek.

The effects to aquatic habitat and fisheries resources from changes to current water quantity and quality that may occur during early reclamation (Years 1 to 5 after mining and milling is completed) would be the following (Section 4.6.1.1.):

- Increased flow to Bruno Creek and S. Creek because upper Bruno Creek would no longer be diverted to the mill;
- Decreased flow (< 0.01 cfs) to S. Creek from Redbird Creek due to decreased seepage from the TSF; and
- Effects to S. Creek water quality during Years 1 to 5 due to ARD from the TSF embankment (not the impoundment) and continued seepage to Redbird Creek. There would be predicted increases in the concentrations of sulfate, arsenic, cobalt, iron, manganese, and nickel for the best estimate during low flow. For the best estimate for the 7Q10 flow there would also be predicted increases in the concentrations of these same constituents plus uranium and zinc. There would be predicted increases in the concentrations of sulfate, arsenic, cobalt, copper, iron, manganese, nickel, uranium, and zinc for the upper estimate for the low flow and 7Q10 flow. The concentrations of all constituents in S. Creek would meet all WQSs.

The effects to aquatic habitat and fisheries resources from changes to current water quantity and quality that may occur during late reclamation (Years 6-plus after mining and milling is completed) would be the following (Section 4.6.1.1.):

- Possible effects to the S. Creek water quality due to the ARD from TSF embankment. There would be predicted increases in the concentrations of sulfate, aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, nickel, uranium, and zinc for both best and upper estimates for the low flow and 7Q10 flow. With the exception of the concentration of cadmium for the 7Q10 flow/upper estimate, the concentrations of these constituents would meet all WQSs;
- Increased flow in the Salmon River as water would no longer be diverted and pumped to the mill and water would be discharged from NPDES Outfall 005; and
- Effects to the Salmon River water quality due to discharge from NPDES Outfall 005, in addition to water from Thompson Creek and S. Creek. There would be predicted increases in the concentrations of sulfate, aluminum, cadmium, cobalt, manganese, selenium, and uranium for both the best and upper estimates for low flow. There would be predicted increases in the concentrations of these constituents, and the concentrations of molybdenum, nickel, and zinc for the 7Q10 flow/best estimate. For the 7Q10 flow/upper estimate there would be a predicted increase in the concentrations of all of these constituents (sulfate, aluminum, cadmium, cobalt, manganese, molybdenum, nickel, selenium, uranium, and zinc) and the concentration of copper. The concentrations of all constituents in the Salmon River would meet all WQSs; and

- Potential effects to water quality due to unanticipated problems in the long-term water management system.

Fish in the Salmon River use the mouths of tributary streams as refuge from warm water temperatures in the Salmon River. Sockeye salmon are considered to exhibit this behavior as well, particularly during summer months. Under upper estimates for water quality in both Thompson Creek and S. Creek, concentrations of copper and cadmium, respectively, may be elevated, particularly during the 7Q10 flow. During periods of low flow, such as the 7Q10 flow, water temperatures in the Salmon River would likely be elevated, and fish would seek thermal refuge. As a result, adult sockeye salmon moving up the Salmon River could be seeking thermal refuge at the mouth of these streams at the same time that concentrations of these contaminants may be elevated. Because some mixing would occur as the tributaries meet the Salmon River, concentrations would be lower than predicted in the tributaries and would likely not exceed water quality criteria. However, in the case of copper, concentrations may still be high enough to result in effects such as sensory impairment. It is highly unlikely that water quality would be a concern in both streams simultaneously. As a result, in a situation with elevated copper in Thompson Creek, S. Creek could also be used as thermal refuge (and vice versa in the case of cadmium).

Aquatic Habitat

As described above, effects would be as a result of changes to water quantity and quality. As there would be only negligible changes in flow rates for Thompson Creek and S. Creek (see below), and there would not be changes to temperature or to indicators not specific to water quantity and quality. Therefore, only the NMFS and USFWS indicators specific to water quantity (peak/base flows) and quality (sediment/turbidity, chemical contamination and nutrients) that could be affected by these changes are discussed in this section. In addition, as there would be no new disturbance under Alternative M1, the effects to disturbance history and riparian reserves are not discussed in this section.

Thompson Creek

Sediment and Turbidity

The current levels of sediment and turbidity (well quantified from more than 30 years of monitoring) would continue during mining and reclamation. Extreme flood events might lead to increased sediment and turbidity from the mine (e.g., those greater than the event for which operational and closure facilities would be designed), but would likely not be excessive as most mine disturbance capable of producing large amounts of sediment (i.e., roads, waste rock facilities, and other similar disturbance) are located away from Thompson Creek. In addition, given that most of the disturbance is located in the Buckskin and Pat Hughes drainages, any sediment released from disturbance in the upper portions of these drainages would be conveyed along Buckskin Creek or Pat Hughes Creek, which have sedimentation ponds in place. The sediment ponds are approximately 0.3 and 0.4 miles from Thompson Creek, respectively. In addition, the amounts of sediment and turbidity in Thompson Creek from the mine during extreme flood events would be small compared to the amounts from areas unaffected by the

mine, especially considering the distance of the majority of the mine disturbance from Thompson Creek.

Chemical Contamination and Nutrients

The construction of cutoff walls would reduce the amount of seepage reaching Thompson Creek from the WRSFs. This would reduce the concentration of most constituents in Thompson Creek; however, there would be an increase in the concentrations of the constituents described in the beginning of this section under both best and upper estimates due to degradation of residual seepage. However, the WQSs would continue to be met under both best and upper estimates (long-term, minor effect). Unanticipated problems with the water management system, particularly the collection and transport of mine-affected water from Buckskin Creek and Pat Hughes Creek to the treatment system could lead to exceedances of WQSs (with exceedance of the selenium standard being the most likely) and potential effects to aquatic life in Thompson Creek. In most cases, this would be a temporary and minor effect as exceedances of the selenium standard occurred between 2000 and 2004 without obvious effects to aquatic life (Section 3.6.1.2).

Peak/Base Flows

The construction of cutoff walls and pond linings would reduce streamflow in Thompson Creek by approximately 1 percent. Under average baseflow conditions (4.2 cfs) the reduction would be 0.04 cfs. Under the less frequent 7Q10 flow (2.0 cfs) the reduction would be 0.02 cfs (negligible effect). Other current effects such as decreased peak flows due to high infiltration rates in the WRSFs and decreased base flows due to water management (i.e., diversion of flows in Buckskin Creek and Pat Hughes Creek) would continue. The current baseflow is a limiting factor to fish populations in Thompson Creek (IDFG 2005a).

S. Creek

Sediment and Turbidity

There would be the same effects to S. Creek as described above for Thompson Creek (negligible).

Chemical Contamination and Nutrients

During mining the S. Creek water quality would be the same as at present (negligible effects). As described in the beginning of Section 4.8.1.1., during Years 1 to 5 there would be increases in the concentrations of several constituents during low flow and the 7Q10 flow under the best and upper estimates. However, even for the upper estimates (the most conservative calculations) all WQSs would be met (short-term, minor effects with seepage to Redbird Creek decreasing over time). During late reclamation (Years 6-plus) there would be increases in the concentrations of several constituents but all WQSs would be met (long-term, minor effect), except for the upper estimates during the 7Q10 flow for which the concentration of cadmium would be greater than the CCC WQS (0.74 µg/L, assuming a hardness of 157 mg/L). Reduction in habitat suitability due to exceedance of WQS for aquatic life during the 7Q10 flow in S. Creek would be a moderate effect. The probability of substantial seepage from the TSF not being captured by the

SRD is low and any WQS exceedances would be temporary (i.e., limited to the low flow period), but the potential for these exceedance "events" would continue long-term.

The effects to Bruno Creek water quality were not evaluated for Years 6-plus because of the current significant effects to aquatic habitat from the mine. However, any seepage not captured by the SRD could reach Bruno Creek. The probability and duration of any seepage reaching Bruno Creek would be the same as for S. Creek. Although re-routing Bruno Creek around the TSF would restore a more natural flow regime to lower Bruno Creek and provide additional water, because Bruno Creek contains less flow to dilute any chemical contamination, the magnitude of effects would be greater than in S. Creek.

Peak/Base Flows

The increase S. Creek streamflow due to seepage from the TSF to Redbird Creek might be approximately 35 gpm (less than 0.08 cfs) during mining and year 1-5 following mining, which would gradually decrease to no flow contribution from Redbird Creek during Years 6-plus following mining when the TSF would be mostly dewatered (negligible effect). The re-routing of Bruno Creek over the top of the TSF after reclamation would increase the amount of water to lower Bruno Creek and S. Creek during peak flow/base flow as the water would no longer be diverted for use in the mill. Although the amount of this increase would be relatively small for S. Creek (negligible effect), there would be more natural flow in lower Bruno Creek, which would benefit fish populations (long-term, moderate effect).

Salmon River

Chemical Contamination and Nutrients

During mining the water quality in the Salmon River would be the same as present. Approximately 30 years after mining water would begin to be removed from the pit lake, treated, and discharged to the Salmon River through Outfall 005 (Section 4.6.1.1). This would lead to higher concentrations of several constituents in the Salmon River under both best and upper estimates (as detailed in the beginning of this section), but all WQSs would be met (long-term, minor effect). Changes in the treatment process (or water discharge rates from the pit lake) may be required to maintain water quality as modeled. TCMC has committed to implement and maintain, in perpetuity, whatever types of treatments are needed to maintain ambient water quality in the Salmon River.

Peak/Base Flows

At the end of mining the withdrawal of water from the Salmon River for the mill would cease and there would be an increase (4.5 cfs) to the flow of the river. Approximately 30 years after mining when treated water would be discharged to Outfall 005, there would be an additional increase (2.03 cfs) to the flow of the river. Compared to the average annual low flow (winter months) of 388 cfs, these increases (1.2 % and 0.5 %) would be negligible effects even during low flow. The effects would be long term as discharge from the pit lake would continue in perpetuity.

Fish Populations

Thompson Creek

The minimal decrease (~ 1 %) in Thompson Creek streamflow and the small changes to water quality under both the best and upper estimates would not be expected to affect either long-term fish population numbers or distribution of bull trout, Chinook salmon, steelhead/rainbow trout, cutthroat trout, or sculpin. Although concentrations of all metals are expected to meet IDEQ criteria for aquatic life, there is the possibility that some metals could bioaccumulate to concentrations sufficient to cause effects. Based on current and predicted water quality in Thompson Creek, only selenium would be of potential concern for bioaccumulation. Excessive selenium bioaccumulation in fish can result in larval developmental abnormalities and mortality (Holm et al. 2005).

Bioaccumulation of selenium occurs in Thompson Creek (Section 3.8.), but ongoing biological monitoring of Thompson Creek shows macroinvertebrate, sculpin, and trout populations have apparently not declined due to the mine operations (Chadwick 2005, GEI 2011). As the concentrations of selenium in Thompson Creek would remain lower than the concentrations in Thompson Creek during the selenium bioaccumulation studies, any effects of an increased concentration of selenium would be negligible.

Any problems in the water management system would lead to temporary increases in sediment and/or chemical constituents downstream of the mine facilities. A pulse of sediment (from a flood event greater than design capacity of the water management facilities) would lead to a decline in habitat quality and possibly spawning habitat. However, the effects of sediment would be mitigated by Thompson Creek also being at flood state with elevated sediment loads from natural conditions outside the mine water management area (short-term, negligible to minor effect). Accidental releases of contaminated water to Thompson Creek from Buckskin Creek or Pat Hughes Creek would not affect fish populations when streamflow in Thompson Creek is above approximately 7 cfs, as there is sufficient flow to dilute inflows from these creeks. At low flows (i.e., less than 7 cfs in Thompson Creek) upsets in the water management system, are much less likely to occur (relative to high flow events greater than design capacity), but would lead to temporary increases in selenium. Temporary increases occurred prior to water management changes (2000 to 2004) with negligible effect to fish populations and effects of an upset in the water management system would be similar (negligible effect).

S. Creek

The minimal increases in streamflow and in concentration of several constituents in S. Creek during mining and during early and late reclamation would not meaningfully affect fish populations in S. Creek under best estimates, as concentrations would meet WQSs (negligible effects). Under the upper estimate during Years 6-plus, there would be the potential for cadmium concentrations to exceed the CCC for aquatic life (1.11 µg/L compared to the CCC of 0.74 µg/L during 4 days). Aquatic organisms should not be affected unacceptably if the four-day average concentration of a constituent does not exceed the CCC more than once every three years on average (EPA 2011a). In the case of cadmium predictions for S. Creek, the frequency of exceedance is predicted to be less than every three years (10 years, by definition under the 7Q10 flow). However, it is possible for the CCC criteria to be exceeded for longer than 4 days

(7 days under the 7Q10 flow) and although the probability of an exceedance is low (only under the most conservative upper estimate during extremely low flow) the potential for effects could not be eliminated.

Cadmium is most toxic to salmonids during the juvenile and larval life stages. In addition, steelhead may be more sensitive to cadmium than Chinook salmon. The 96 hour LC50 (the concentration that is lethal to 50 % of the organisms) for steelhead was as low as 1.0 µg/L cadmium for steelhead parr and 1.8 µg/L cadmium for Chinook salmon swim-ups (Chapman 1978). Mebane et al. (2012) studied sensitivity to cadmium for cutthroat trout, rainbow trout, and shorthead sculpin and found 96 hour EC50s (the concentrations causing a specified effect on 50 % of the organisms, in this case loss of equilibrium, immobilization, or death) ranging from 0.3 to 1.5 µg/L. However, in both these studies the water hardness was much lower (< 70 mg/L) than in S. Creek (157 mg/L), and cadmium toxicity decreases substantially with increases in hardness. For example, the Idaho WQS for the CCC for cadmium (0.6 µg/L for a hardness of 100 mg/L) would be 0.5 µg/L for a hardness of 70 mg/L and 0.8 µg/L for a hardness of 157 mg/L.[4] Mixtures of metals also typically have interactive effects leading to toxicity at lower or higher concentrations than from a single metal alone (Finlayson and Verrue 1982). Cadmium does not readily bioaccumulate in fish (EPA 2001).

The possible effects to fish in S. Creek from the predicted concentration of cadmium during the 7Q10 flow would include low levels of the typical effects of cadmium to fish: reduced survival of larval fish; avoidance behavior that may limit feeding, migration, or predator avoidance. These could lead to a short-term decrease in juvenile recruitment for the year of an exceedance; a decline in fish population size; or reduced health of adult fish. With the temporary nature of cadmium effects, declines in fish population size would be small, and populations would rebound in subsequent years. Given the low numbers of bull trout, Chinook salmon, and spawning steelhead in S. Creek, the effects of elevated concentrations of cadmium could be more pronounced than for the more common rainbow trout and cutthroat trout, in that it would take longer for populations to recover from a particular event. As a result, effects would be moderate (i.e., would not affect persistence in S. Creek, but would be sufficient to be seen on a population scale due to reduced recruitment and smaller population numbers). Although individual "events" would be short-term, the potential for them to occur is long-term.

As described above (S. Creek, chemical contamination and nutrients), the effects of increased concentrations of constituents might be greater to cutthroat trout in lower Bruno Creek where concentrations of constituents could be higher than in S. Creek. In such case, the effects to fish populations (cutthroat trout) in Bruno Creek would probably be either the same as for S. Creek (long-term, moderate effect) or greater (long-term, major effect). Probability and frequency of effects would be the same as described for S. Creek. A major effect would be the same as was described for Bruno Creek (e.g., the substantial destruction of the aquatic habitat and fish populations) for the 1980 EIS (USFS 1980). Also, water management would be focused on reducing the potential for seepage to Bruno Creek and S. Creek from the TSF (currently all seepage is captured at the SRD and pumped back to the mill, which prevents it from reaching Bruno Creek and S. Creek) which would reduce the potential for the effects described above.

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[4] $1.0 \times e^{[0.6247\ln(\text{hardness}) - 3.344]} \times 0.909$ (IDAPA 58.01.02.210.02)

Salmon River

The water quality after reclamation would have increased concentrations of the constituents previously described, but would meet all WQSs for both best and upper estimates during both low flow and the 7Q10 flow (negligible effect).

Macroinvertebrate Organisms

Thompson Creek

An increase in the concentrations of several constituents could cause reduced overall taxa richness and fewer EPT taxa, as described in Section 3.8.1.5. However, all WQSs would be met under the best and upper estimates (long-term, minor effect). Selenium has the potential to bioaccumulate in macroinvertebrate organisms, but monitoring has shown no clear trends or declines in macroinvertebrate populations due to mine operations (Chadwick 2005, GEI 2011), including selenium bioaccumulation (negligible effect). Effects from upsets in the mine water management system could include both sediment and chemical contamination. A pulse of sediment may lead to a decline in habitat quality for macroinvertebrates (due to the filling of interstitial spaces), but would not affect long-term population numbers or community compositions, as the stream would be expected to return to baseline equilibrium conditions as the sediment is transported out of the system (temporary to short-term, negligible to minor effect). Effects of accidental chemical contamination on macroinvertebrate organisms would be the same as described for fish populations (negligible effect).

S. Creek

An increase in the concentrations of several constituents could cause reduced overall taxa richness and fewer EPT taxa, as described in Section 3.8.1.5. However, all WQSs would be met during mining, under the best and upper estimates during Years 1 to 5 (short-term, minor effect), and under the best estimate during Years 6-plus (long-term, minor effect). For the upper estimate during Years 6-plus, the potential for concentrations of cadmium greater than the CCC for aquatic life would include greater decreases in overall taxa richness and taxa richness of metals-sensitive orders than described for the other scenarios (changes in community composition on the population scale). Any such effects would cease following extreme low flow periods (predicted to occur only under infrequent 7Q10 flow and only under the most conservative estimates), but the potential to occur would continue long-term (long-term, moderate effect).

Salmon River

There would be at most slight (but measureable) decreases in taxa richness (no changes in the community composition or overall abundance) for metal-sensitive orders (long-term, minor effect).

4.8.1.2. Alternative M2 – MMPO as Submitted by TCMC

There would be increased disturbance in both the Thompson Creek and S. Creek watersheds due to expansion of the WRSFs and the TSF. This would include Pat Hughes Creek (and tributary) channel (3,749 feet), Bruno Creek (and tributaries) channel (1,204 feet), and Mill Creek channel (4,397 feet) (as part of reclamation) (Section 4.9.1). The additional disturbance in the Buckskin

Creek drainage would be in the upper watershed and would not disturb any additional reaches of the stream. Because these creeks have already been heavily modified by the mine, the majority of the potential effects to aquatic habitat and fisheries resources would be due to changes in water quantity and quality. During mining the changes that would affect aquatic resources would be the following (Section 4.6.1.2.):

- Negligible reductions in flow in Thompson Creek (2 % relative to current conditions, an additional 1 % relative to Alternative M1,) due to increase disturbance in the drainage and the additional cutoff walls in the Pat Hughes Creek drainage;
- Decreased concentrations of many constituents (relative to current conditions) in Thompson Creek (other than described below) for both the best and upper estimates due to installation of the cutoff walls;
- Additional degradation of water quality in Thompson Creek due to the expansion of the WRSFs. The concentrations of aluminum, copper, manganese, and molybdenum would be predicted to increase for the best estimate for low flow and the 7Q10 flow. The concentrations of aluminum, cadmium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, uranium, and zinc would be predicted to increase for the upper estimate for both low flow and the 7Q10 flow. With the exception of copper for the upper estimate under the 7Q10 flow, the concentrations of all of these constituents would meet all WQSs;
- Additional, but small increases in the flow in S. Creek (~ 0.03 cfs relative to current conditions and 0.01 cfs relative to Alternative M1) due to increased seepage to Redbird Creek; and
- Additional, but small increases in the flow in the Salmon River during mining (~ 0.4 cfs).

During Years 1 to 5 and Years 6-plus after mining and milling is completed changes to water quantity and quality would be the same as for Alternative M1, with the exception of the following (Section 4.6.1.2.):

- The same constituents predicted to increase in S. Creek for Alternative M1 during Years 1 to 5 would increase, but the predicted concentrations would be slightly higher.
- There would be an increase in the concentration of manganese in S. Creek (for which there is no WQS) during Years 1 to 5 for both the best and upper estimates for both low flow and the 7Q10 flow (no increase during Years 6-plus).
- There would be negligible increases in the flow in the Salmon River following reclamation (6.6 cfs compared to 6.5 cfs under Alternative M1); and
- The concentrations of the constituents in the Salmon River would increase slightly relative to Alternative M1 but would meet WQSs.

The increased amount of waste rock in the Buckskin Creek and Pat Hughes Creek drainages would contribute dissolved solutes to mine-affected water and potential effects to Thompson Creek. Additional cutoff walls included under Alternative M2 would reduce some of these effects and predicted concentration of some constituents (arsenic, cadmium, iron, lead, and nickel) would be the same under Alternative M2 as Alternative M1; however, others would increase. Under all scenarios, predicted concentrations of constituents in Thompson Creek would meet IDEQ WQSs, with the exception of copper under the upper estimate for the 7Q10 flow. The predicted upper estimate for copper during the 7Q10 flow would be 8.24 µg/L, which would exceed the CCC of 6.0 µg/L (assuming a hardness of 47 mg/L). Changes to water quality in S. Creek and the Salmon River would be similar to those described under Alternative M1 for all scenarios, with only slight increases in concentrations of the same metals described for Alternative M1 during Years 1 to 5 for S. Creek and the Salmon River. The predicted concentrations under all estimates for Years 6-plus would be the same as described for Alternative M1. Monitoring and adaptive management related to water quality is summarized in Section 2.1.6. and Section 4.21.

Aquatic Habitat

Effects to aquatic habitat are similar to those described under Alternative M1 for sediment and turbidity (with the exception of the additional cutoff wall in Pat Hughes WRSF, the overall water management during operation and closure is unchanged between these two alternatives). As a result, the effects for sediment and turbidity would be the same as for Alternative M1. Changes to disturbance history and riparian reserves would occur in the Thompson and S. Creek watersheds, and are discussed below along with chemical contamination and nutrients, and peak/base flows.

Thompson Creek

Chemical Contamination and Nutrients

There could be an increase in the concentrations of several constituents from increased constituent loads in seepage passing around the additional cutoff walls due to increased areas taken up by the WRSFs and continued/predicted degradation WRSF seepage. The concentrations of copper, lead, and manganese would increase under the best estimate for both the annual low flow and the 7Q10 flow; and aluminum, cadmium, cobalt, copper, iron, lead, manganese, uranium, and zinc under the upper estimate for both the annual low flow and the 7Q10 flow. Under the best estimate and upper estimate/low flow scenarios, all WQSs would be met (long-term, minor effect). Under the most conservative 7Q10 flow/upper estimate scenario, the concentration of copper (8.24 µg/L) could exceed the CCC WQS (6.0 µg/L) (long-term, moderate effect). Although the individual exceedances would be temporary (i.e., limited to the 7Q10 flow), the potential for these exceedance "events" would continue long-term.

Peak/Base Flows

There would be a reduction in the flow of Thompson Creek of 0.01 cfs (1 %) during the 7Q10 flow in addition to a reduction of 0.01 cfs under Alternative M1 (negligible effect).

Disturbance History

There would be approximately 2,100 acres of disturbance in the Thompson Creek watershed compared to 1,824 acres for Alternative M1 (long-term, minor effect to aquatic habitat).

Riparian Reserves

There would be no disturbance along Thompson Creek, but the expansion of the Pat Hughes WRSF would permanently remove 3,749 feet of the Pat Hughes Creek channel/tributary and their (discontinuous) riparian vegetation. However, Pat Hughes Creek is part of the water management system and is no longer a natural waterway and there would be little change relative to functional aquatic habitat (negligible effect).

S. Creek

Chemical Contamination and Nutrients

During mining the loads of sulfate and chloride to Redbird Creek would increase, but given the small proportion of the flow of S. Creek from Redbird Creek, the effects to water quality and aquatic habitat would be negligible. During Years 1 to 5 after closure the seepage would continue in the short term, and water quality would essentially be the same for both the best and upper estimates as for Years 1 to 5 for Alternative M1 (short-term, minor effect). During Years 6-plus, the concentrations of all constituents would be similar to Alternative M1, with slightly higher concentrations for some constituents. With the exception of cadmium under the most conservative 7Q10 flow/upper estimate, all concentrations would meet WQS (long-term, minor effect). The effects of concentrations of cadmium above the CCC WQS would be the same as for Alternative M1 (infrequent moderate effect with potential to occur long-term).

Peak/Base Flows

There would be small (0.02 cfs) increases in flow to S. Creek due to seepage to Redbird Creek in addition to the 0.01 cfs for Alternative M1 during mining and Years 1 to 5 after mining (negligible effect). The increased flow would gradually decrease to zero during Years 6-plus when the TSF would be mostly dewatered.

Disturbance History

There would be 1,163 acres of disturbance in the S. Creek watershed compared to 992 acres for Alternative M1 (long-term, minor effect).

Riparian Reserves

There would be no disturbance along S. Creek. However, the TSF would permanently remove (discontinuous) riparian vegetation along 1,204 feet of Bruno Creek and its tributaries, and 4,379 feet of Mill Creek (tributary to Bruno Creek). The affected reaches of these S. Creek tributaries are currently fragmented by the TSF and SRD. As a result, the decrease in riparian habitat would be isolated from S. Creek and lower Bruno Creek. The removal of 1,204 feet of stream channel in upper Bruno Creek would have little affect because the riparian vegetation would be so sparse (negligible effects).

Salmon River

Chemical Contamination and Nutrients

During mining water quality would be the same (negligible effects). After reclamation and the start of pit lake discharge through NPDES Outfall 005, the concentration of several constituents would be higher under both the best and upper estimates. The concentrations of constituents predicted to increase would be the same as described for Alternative M1 (with most predicted concentrations the same as under Alternative M1, some slightly higher). The concentrations would meet all WQSs under both best and upper estimates (long-term, minor effects). As described for Alternative M1, meeting water quality criteria would require that all water discharged to the Salmon River be treated prior to discharge, and changes in the treatment process (or water discharge rates) may be required to maintain water quality. TCMC has committed to implement and maintain, in perpetuity, whatever types of treatments are needed to maintain ambient water quality in the Salmon River.

Peak/Base Flows

During mining there would be a small increase (0.4 cfs, 0.1 % of the average annual low flow) in the flow of the Salmon River as the deeper open pit would intercept more groundwater that would be used instead of withdrawing water from the river (it would be more economical to pump from the pit than the river) (negligible effect). After reclamation there would be 2.11 cfs of treated water discharged to the Salmon River, compared to 2.03 cfs under Alternative M1. Combined with the 4.5 cfs that would no longer be withdrawn at the end of mining, the increase in the flow of the Salmon River would be 6.61 cfs, or 6.4 percent of the 7Q10 flow of 103 cfs (long-term, minor effect), and 1.7 percent of the average annual flow (negligible effect).

Fish Populations

Thompson Creek

There would be very minimal (1 %) additional effects to streamflow (relative to Alternative M1) and although constituents would increase relative to baseline condition (with slight increases for some relative to Alternative M1), the concentrations under the best estimate and the upper estimate under all but extreme low flows would meet WQSs (negligible effect). The concentrations of copper under the most conservative upper estimate (8.24 µg/L) are predicted to exceed the CCC WQS (6.0 µg/L assuming a hardness of 47 mg/L, see Section 4.6.1.2.) during the 7Q10 flow. As explained for cadmium in S. Creek (Section 4.8.1.1.), fish may be affected under a scenario where the CCC criteria is exceeded during the 7Q10 flow because it is possible for the CCC to be exceeded for longer than 4 days (i.e., 7 days).

Copper can have a variety of effects on salmonids including mortality, reduced olfactory function, interference with migration, and an impaired immune response (Chapman 1978, Baldwin et al. 2003, Woody 2007). Similar to cadmium, copper is most toxic to salmonids during the juvenile and larval life stages (Chapman 1978). Chapman (1978) also found that steelhead are more sensitive to copper than Chinook salmon. The 96 hour LC50 (the concentration lethal to 50 % of the organism) for steelhead was as low as 17 µg/L for steelhead parr (age 1-3) and 19 µg/L for Chinook salmon swim-ups (larval fish just emerging from spawning gravels). Copper toxicity decreases with an increase in hardness. The hardness

identified in the studies of Chapman (1978) (22 to 67 mg/L) compared to the hardness (47 mg/L) associated within Thompson Creek indicates the toxicity results would be comparable to Thompson Creek.

Copper may affect fish at concentrations lower than that which would cause mortality and lower than some state WQSs (Woody 2007). Several studies (e.g., Baldwin et al. 2003, 2011) have shown that short-term, small increases (3 µg/L) in the concentration of copper can impair olfactory function in coho salmon and steelhead. These effects can be at least partially reversible, although the effects from exposures more than 4 hours may take weeks to reverse (Baldwin et al. 2003). Loss of olfactory function can subsequently influence feeding, predator avoidance, and migration (Woody 2007). Furthermore, exposure to sub-lethal concentrations of copper can increase fish stress, which subsequently increases both infection and mortality rates (Woody 2007).

The upper estimates for copper during the 7Q10 flow would not result in direct mortality, but may have lower level effects on behavior and disease susceptibility that might indirectly reduce survival, i.e., short-term declines in fish population size for bull trout, Chinook salmon, steelhead/rainbow trout, cutthroat trout, and sculpin. Regardless, there would not be a reduction in fish population viability in Thompson Creek as reproduction and recruitment in subsequent years would be unaffected. Although the probability is low (based on conservative upper estimates), effects could be of a magnitude sufficient to be seen on a population scale (behavioral effects and disease susceptibility that may reduce survival). As a result, the effects would be moderate. Although individual "events" would be short-term, the potential for them to occur is long-term. The slightly increased concentrations of selenium (relative to Alternative M1) would be lower than the concentrations measured from 1999 to 2010 (negligible effects from bioaccumulation).

S. Creek

The effects would be essentially the same as for Alternative M1, with only negligible decreases in water quantity and minor changes to water quality during mining and Years 1 to 5 due to increased seepage to Redbird Creek (short-term, negligible effects under both best and upper estimates during Years 1 to 5; long-term, negligible effects for best estimate for Years 6-plus). Under upper estimates, there would be the potential for cadmium exceedances during the 7Q10 flow (moderate effects). The duration of moderate effects would be short-term, but with the potential to occur over the long term.

Salmon River

Effects to fish in the Salmon River would be negligible as described for Alternative M1.

Macroinvertebrate Organisms

Thompson Creek

Under best estimates, there would be the same effects to macroinvertebrate organisms in Thompson Creek as for Alternative M1, which may include reduced overall richness and fewer metal intolerant taxa such as the EPT taxa (long-term, minor effect). Under upper estimates, effects would include greater decreases in overall taxa richness and taxa richness of metals-

sensitive orders if the CCC for copper were exceeded. As these effects would be seen on a population scale, with changes in community composition, the effects would be moderate. It is expected that community composition would recover following extreme low flow periods (exceedances are only predicted under the 7Q10 flow) and moderate level effects would be short-term. However, the potential for exceedances to occur would continue long-term.

S. Creek

These effects would be the same as previously discussed (Alternative M1) for the best and upper estimates for Years 1 to 5 (short-term, minor effects) and best estimates for Years 6-plus (long-term, minor effects). The effects under the most conservative upper estimate for the potential cadmium exceedance in S. Creek would also be the same as described for Alternative M1(moderate effect that would be short-term in duration with the potential to occur long-term).

Salmon River

The effects to macroinvertebrate organisms in the Salmon River would be essentially the same as for Alternative M1 (long-term, minor effect).

4.8.1.3. Alternative M3 – No Name Waste Rock Storage Facility

Under Alternative M3 the majority of water management would continue unchanged from Alternative M2, and the effects to S. Creek and the Salmon River would be similar to the effects for Alternative M2 (Section 4.8.1.2). Any differences between the effects for Alternative M3 and the effects for Alternative M2 would be in the Thompson Creek watershed. The No Name Creek is intermittent and does not contain fish. The No Name WRSF would disturb up to 5,606 feet of intermittent stream channel (74 % of the surveyed channel length), in addition to the new disturbance of 3,749 feet of the Pat Hughes Creek channel, 1,204 feet of the Bruno Creek channel, and 4,397 feet of the Mill Creek channel. Other than this disturbance to tributaries, effects to Thompson Creek fish and aquatic resources would be through effects to water quantity and quality as described for other alternatives.

The effects to Thompson Creek compared to the effects for Alternative M2 would be reduced flow (run-off) from No Name Creek (as mine-affected water would be collected and used for mining, and after mining the water would be treated and discharged to the Salmon River) and potential seepage from the No Name WRSF that could degrade shallow groundwater discharging to Thompson Creek (Section 4.6.1.3).

Calculations of water quality were not made for Alternative M3 because of the lack of data for the No Name Creek drainage, and because the potential effects to Thompson Creek from the WRSFs in the adjacent Buckskin Creek and Pat Hughes Creek drainages are well defined for Alternative M1 and Alternative M2 and may be generally applied to the No Name Creek drainage for a conservative analysis. It is unknown to what extent a cutoff wall or other mechanism would capture seepage from a WRSF in the No Name Creek drainage and prevent the seepage from discharging to Thompson Creek. Therefore, construction of a new WRSF in the No Name Creek drainage would probably result in similar effects to groundwater quality as have already occurred at the Buckskin and Pat Hughes WRSFs. It may be possible for an underdrain system to be installed that would capture most if not all the seepage and limit the

contamination of shallow groundwater that reaches Thompson Creek. However, any groundwater effects from the No Name WRSF would be additive to that which would occur under Alternative M1.

Aquatic Habitat

The effects to aquatic habitat for S. Creek and the Salmon River would be the same as described for Alternative M2 (Section 4.8.1.2). For Thompson Creek, the effects to sediment, turbidity, and water management during operations and closure would be similar between these two alternatives. The changes to disturbance history and riparian reserves are discussed below along with chemical contaminants and nutrients and peak/base flows.

Thompson Creek

Chemical Contamination and Nutrients

The concentrations of various constituents reaching Thompson Creek from shallow groundwater would at a minimum be the same as under Alternative M2, if not greater, and there would be very similar probabilities of a similar exceedance of the CCC for copper under upper estimates during the 7Q10 flow (long-term, moderate effect). Constituents other than copper would remain below WQSs under scenarios similar to the best estimates used for Alternative M2 (long-term, minor effect).

Peak/Base Flows

Using drainage area as an analog to flow production, the No Name Creek WRSF would cause a slightly greater percentage of decreased surface water flow to Thompson Creek than under Alternative M2 (Section 4.6.1.3.) (negligible effect).

Disturbance History

There would be 2,244 acres of disturbance in the Thompson Creek watershed compared to 1,824 acres for Alternative M1 and 2,100 acres for Alternative M2. Similar management to that used in the Buckskin and Pat Hughes drainages (sedimentation ponds, pumping of contaminated water to the mill, etc.) would reduce the effects of disturbance (long-term, minor effect).

Riparian Reserves

As for Alternative M3, there would be no disturbance along Thompson Creek, and the effects to Thompson Creek from sediment and turbidity would be essentially the same as for Alternative M2. However, the Pat Hughes WRSF would still need to be enlarged which would permanently remove 3,749 feet of stream channel and (discontinuous) riparian vegetation in the Pat Hughes Creek drainage. The stream is now part of the water management system and would no longer function as a natural stream with an altered channel, sedimentation ponds, and no discharge during many years (same effect as for Alternative M2). As a result, there would be little change in baseline condition relative to current occupied aquatic habitat in Thompson Creek (negligible effect).

Fish Populations

The minimum effects to fish populations would be essentially the same as for Alternative M2, with the possibility for greater effects depending on changes in water quality from No Name Creek and the accompanying water management strategies.

Macroinvertebrate Organisms

The minimum effects to macroinvertebrate organisms would be essentially the same as for Alternative M2, with the possibility for greater effects depending on changes in water quality from No Name Creek and the accompanying water management strategies.

4.8.2. Land Disposal Alternatives

4.8.2.1. Alternative L1 – No Action

There would be no change to the current condition for aquatic habitat and fisheries resources on the selected or offered lands. The selected land would have 9.6 miles of suitable aquatic habitat for fish populations all of which is designated critical habitat for Chinook salmon (includes Thompson Creek, Buckskin Creek below mine disturbance, Pat Hughes Creek below mine disturbance, S. Creek, and Bruno Creek both above and below the TSF). There would be 5.4 miles of designated critical habitat for bull trout and steelhead in S. Creek and Thompson Creek.

The pond and associated culvert on lower Lyon Creek would continue to be an impediment to upstream fish passage and source of sediment, as well as the vehicle fords. There would continue to be distinct erosion/streambank sloughing in the lower 1,850 feet of Lyon Creek and use of the riparian corridor by livestock, along with little pool habitat and sparse riparian vegetation. The pond would impede the upstream migration and use of Lyon Creek by anadromous fish (e.g., Chinook salmon, steelhead) and fluvial migrants (e.g., bull trout, westslope cutthroat trout) such that there would continue to be effects on a population scale, in this case by reducing the distribution of these species. All fish habitat on the ranch would remain under private ownership, which would include 4.6 miles of designated critical habitat for Chinook salmon on Lyon Creek and 3.7 miles of the Salmon River, which is designated critical habitat for bull trout, Chinook salmon, sockeye salmon, and steelhead. For the Garden Creek property, fish populations would probably be small and/or not present and there would be no ESA-listed species or habitat on the property.

4.8.2.2. Alternative L2 – Land Exchange Proposal

There would be negligible effects to aquatic resources on the selected land (including special status species). The Thompson Creek and S. Creek Conservation Easement would prevent any meaningful disturbance to Thompson Creek or the Thompson Creek riparian corridor on the selected land, i.e., nothing would be allowed that would materially degrade the riparian values for which the easement was established. The easement would also prohibit the subdivision or residential development of S. Creek, and no other actions which could materially affect the S. Creek riparian area in the selected land are reasonably foreseeable. The BLM ranch management strategies relevant to aquatic resources would be the following:

- Lyon Creek would be managed with a focus on fisheries resources and any unscreened water diversions would be screened to prevent entrainment of downstream migrating fish;
- The pond near the Salmon River confluence would be removed to eliminate the barrier to upstream fish movement; and
- A portion of the ranch adjacent to the Salmon River would be rested from grazing and subjected to weed eradication.

Implementation of the Lyon Creek restoration plan would also improve riparian vegetation/pool habitat and reduce erosion, streambank sloughing, and sediment input to the lower 1,850 feet Lyon Creek, as well as exclude livestock grazing from the riparian corridor. Such would cause decreased water temperatures and improved fish habitat, thermal refuge for fish from the Salmon River, and fish passage in lower Lyon Creek. Screening of any unscreened diversions would prevent fish entrainment. Coupled with the removal of the pond, there would be increased habitat in the Salmon River system for bull trout, Chinook salmon, steelhead, and cutthroat trout. These species currently use the portion of Lyon Creek below the pond for thermal refuge and, in the case of steelhead, possibly for spawning (not confirmed). Any of the unscreened diversions along Lyon Creek that would still be used would be screened (long-term, beneficial, moderate effects). Resting portions of the ranch from grazing (BWR-7) would increase riparian vegetation along the Salmon River (negligible effect due to the small amount of rested area). Also, there would be a negligible effect to aquatic resources (e.g., less redd and streambank trampling or potential harassment of individual fish) due to the small amount of riparian area that could be accessed by livestock under Alternative L2. Further, some additional disturbance to individual fish and/or habitat could occur due to the public having access to what has historically been private property. Under Alternative L2-B the area of the ranch converted to native vegetation would not be grazed (negligible effect due to the small riparian area that would otherwise be accessible to livestock).

Under Alternative L2 the 9.6 miles of known or suitable aquatic habitat and designated critical habitat for Chinook salmon would leave Federal jurisdiction. However, approximately half (4.2 miles) of this designated critical habitat would be the lower portions of Buckskin Creek, Pat Hughes Creek, and Bruno Creek. These portions of the drainages are not occupied and could not be occupied by Chinook salmon in all but the most downstream reaches (i.e., movement upstream of the stream mouths is prevented by dewatering, sediment ponds, etc.) due to the use of these portions of the drainages as part of the water management system for the mine for the foreseeable future. The remaining 5.4 miles of the habitat would be Thompson Creek and S. Creek, which are designated critical habitat for steelhead and bull trout. These streams would be occupied by juvenile Chinook salmon, steelhead, and bull trout. In addition, these streams are larger and lower gradient than Lyon Creek, and might support spawning in the future. All of the aquatic habitat on the portion of Thompson Creek on the selected land would be protected by a conservation easement. The portion of the S. Creek easement area could not be subdivided or residentially developed, and no other actions which could materially affect the S. Creek riparian area in the selected land are reasonably foreseeable (negligible effect).

Under Alternative L2 the 4.6 miles of known or suitable aquatic habitat and designated critical habitat for Chinook salmon (Lyon Creek and Salmon River) on the Broken Wing Ranch would enter Federal jurisdiction. The 3.7 miles of this habitat along the Salmon River is also designated critical habitat for Chinook salmon, sockeye salmon, steelhead, and bull trout. The ranch would also provide the only effective access to 2.9 miles of fish habitat (also designated critical habitat for Chinook salmon) on Lyon Creek on BLM land upstream of the ranch (approximately 1.9 miles of which is known to currently support fish populations; with approximately 1 mile upstream of a seasonally dry reach). However, Lyon Creek is a smaller stream than Thompson Creek or S. Creek with a small watershed, narrow width, higher gradient along much of its length (the lower ¼-mile is lower gradient), and water use for agriculture. As a result, the value of Lyon Creek for fisheries may be less than the value of the fisheries in Thompson Creek and S. Creek. However, the fish habitat of Thompson Creek would be protected by a conservation easement, there could be no subdivision or residential development in the S. Creek riparian area in the selected land, and no actions that could materially affect the S. Creek riparian area in the selected land are reasonably foreseeable (negligible effects). Under Alternative L2-B the additional vehicles crossing the Lyon Creek ford would cause additional turbidity and sediment deposition for approximately 50 feet downstream (Section 3.8.2.2.) (long-term, negligible or minor effect). There would be no effects to aquatic habitat and fisheries resources at the Garden Creek property under Alternative L2.

4.8.2.3. Alternative L3 – Land Sale

The designated critical habitat on the selected land for Chinook salmon (9.6 miles) and suitable or currently occupied fish habitat (5.4 miles, designated critical habitat for Chinook salmon, steelhead, bull trout) would leave Federal jurisdiction, but would be protected by a conservation easement (no material effects could occur in the Thompson Creek riparian corridor in the selected land; no subdivision or residential development could occur in the S. Creek riparian corridor in the selected land; and no actions which could materially affect the S. Creek riparian corridor in the selected land are reasonably foreseeable) (negligible effect). The effects to the Broken Wing Ranch under Alternative L3 would not occur, e.g., removal of the impediment to fish movement on Lyon Creek would continue (long-term, negligible to moderate effects).

4.8.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The selected land would contain only 500 feet of S. Creek instead of 2,500 feet under Alternative L2 (Figure 2.2-1), but all of the S. Creek riparian corridor that would leave Federal jurisdiction could not be subdivided or residentially developed, and no other actions which could materially affect the S. Creek riparian corridor in the selected land are reasonably foreseeable. Accordingly, 8.0 miles of aquatic habitat (including 3.8 miles of suitable fish habitat also designated critical habitat for Chinook salmon, steelhead, and bull trout) would leave Federal jurisdiction (negligible effect).

Regarding the offered lands, the subparcels on the ranch with the most valuable aquatic habitat would be BWR-1, BWR-2, and BWR-3 which include portions of Lyon Creek (Table 4.8-1). If the US would not acquire these subparcels, some of the beneficial effects to fish described for Alternative L2 would not occur (long-term, moderate effect). Rather, the effects would be the same as described for Alternative L1 or Alternative L3, but could be altered by IDFG work (e.g., new installations, repairs) on fish screens or removal of the pond. Some effects to aquatic habitat

could occur if the parcels adjacent to the Salmon River were acquired (BWR-4, BWR-6, and BWR-7), but the effects would be limited to a possible increase in riparian vegetation as described for Alternative L2 (negligible effect).

Table 4.8-1. Aquatic habitat at the Broken Wing Ranch.

Length of Habitat (miles)							
BWR-1	**BWR-2**	**BWR-3**	**BWR-4**	**BWR-5**	**BWR-6**	**BWR-7**	**TOTAL**
0.6	1.2	0.2	1.2	0.0	1.4	0.6	4.6

The sum of the mileage reported for the individual parcels is greater than the total due to some parcels containing the same portion of the Salmon River (i.e., opposite sides of the riverbank).

4.8.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects to the selected land would be the same as under Alternative L2, i.e., the only meaningful aquatic habitat on the selected land that would remain under Federal jurisdiction compared to Alternative L2 or Alternative L3 would be a short length (2,500 feet) of the S. Creek riparian corridor. However, none of this corridor on the selected land could be subdivided or residentially developed, and no actions which could materially affect this portion of the corridor are reasonably foreseeable. The effects to the offered lands would be the same as under Alternative L4.

4.9. Wetlands, Floodplains, and Riparian Areas

4.9.1. MMPO Alternatives

There would be direct effects and a potential for indirect effects to wetlands, riparian areas, and WUS[5] as a result of the MMPO alternatives. Tailings, waste rock disposal facilities, and other surface disturbances within the analysis area would cause direct effects by filling wetlands and stream channels which would cause a loss of wetland acreage and function. These effects would be major, permanent, and would occur immediately at the time of disturbance. Indirect effects would be caused by changes in hydrology downstream of the disturbances that could disrupt wetland hydrology and function.

TCMC diverts as much water around the mine facilities as is feasible. All water that contacts the facilities is potentially affected in quality and is therefore collected and typically used in the mill. Therefore, this water has not flowed into the Buckskin and Pat Hughes drainages for more than 30 years. As a consequence, some wetlands not directly destroyed (e.g., covered by waste rock) in these drainages may have been damaged or destroyed over the years due to decreases in water availability (baseline condition). The additional surface disturbance of the MMPO action alternatives would have only negligible effects on surface water quantity below the mine facilities under Alternative M2 and Alternative M3 (Section 4.6). A groundwater cutoff wall that will be installed as part of Phase 7 (Alternative M1 – No Action) at the Buckskin WRSF would

[5] There would not be any effects to floodplains (i.e. mapped 100 year floodplains) because these features are not present within the analysis area.

affect the amount of colluvial groundwater that flows downstream of the facility; however, the amount of colluvial groundwater captured would not change under the MMPO action alternatives. The groundwater cutoff walls installed at the Pat Hughes WRSF as part of the MMPO alternatives would reduce the amount of groundwater that discharges from beneath the Pat Hughes WRSF (Section 4.6); however, there were no wetlands identified downstream of the Pat Hughes WRSF. Therefore, there would not be any indirect effects to wetlands related to water quantity.

4.9.1.1. Alternative M1 – No Action

The wetlands within the current disturbed area at the mine, outside of the Mill Creek watershed, adjacent to linear features such as power lines, reclaimed roads, pipelines, fiber optic lines, and undisturbed areas in the vicinity of the WRSFs would not be affected. During reclamation there would be disturbance in the upper portion of the Mill Creek drainage that would affect up to 2.93 acres of wetlands in the drainage. However, the wetlands in the drainage were evaluated by the USACE for only disturbance under Alternative M2, i.e., the effects to wetlands in the drainage for Alternative M1 would not be known. Regardless, such effects would be less than the (fully evaluated) effects to wetlands that would occur in the drainage under the MMPO action alternatives.

4.9.1.2. Alternative M2 – MMPO as Submitted by TCMC

Alternative M2 and the Mill Creek reclamation/closure activities would result in the fill or burial of 3.39 acres of jurisdictional wetlands within the MMPO analysis area (Table 4.9-1). The majority of the wetlands affected consist of PEM wetlands followed by PFO wetlands and a small seep wetland. This would comprise direct effects to 74 percent of the jurisdictional wetlands in the Alternative M2 analysis area. This would be a permanent, major direct effect on wetlands within the analysis area. A wetlands mitigation plan (HDR 2014b) would be implemented by TCMC to mitigate these effects (Section 4.21.4. and Appendix B).

A total of 10,641 feet of stream length designated as WUS in the analysis area (34 % of the stream length in the analysis area) (Section 3.9.) would be filled by the WRSFs, inundated by the TSF, disturbed by the relocation of the Pat Hughes sediment pond, or disturbed during reclamation (Table 4.9-2.) (permanent, major effect). A 404(b)(1) alternatives analysis (HDR 2014a) would provide the USACE with the information necessary to determine whether Alternative M2 would comply with 40 CFR 230.10(a) of the 404(b)(1) guidelines (Appendix A). TCMC would implement a wetlands mitigation plan to mitigate the effects to wetlands (including stream channels) (Section 4.21., Appendix B).

Table 4.9-1. Effects to wetlands, Alternative M2.

Wetland ID (Figure 3.9-1.)	Affected[1] (acres)	Type[2]	JD[3] Status
PH Tributary Spring	0.05	PEM	Yes
PH1	0.21	PEM	Yes
BR2	0.032	PFO	Yes
WB1	0.025	PFO	Yes
WB2	0.108	PFO	Yes
WBWet1	0.004	PEM	Yes
WBWet2	0.003	PEM	Yes
Wetland1	0.036	PFO	Yes
MC1[4]	0.217	PEM	Yes
MC3[4]	0.21	PEM	Yes
MC4[4]	0.796	PEM	Yes
MC5[4]	0.127	PEM	Yes
MC6[4]	0.811	PEM	Yes
MC7[4]	0.153	PEM	Yes
MC8[4]	0.406	PEM	Yes
MC9[4]	0.203	PEM	Yes
MC Spring[4]	0.002	Spring	Yes
TOTAL	**3.39**		

[1] Due to the small size of the wetlands in the analysis area, if any portion of a wetland was in the analysis area the entire wetland was assumed to be affected (i.e. inundated, filled, or excavated).
[2] Cowardin et al. 1979
[3] jurisdictional determination
[4] Mill Creek drainage wetlands that would be disturbed under Alt. M2 and during reclamation.
BR = Bruno Creek; MC = Mill Creek; PH = Pat Hughes Creek; WB = West Fork Bruno Creek

Table 4.9-2. Effects to stream channels, Alternative M2.

Stream	Length Affected (feet)	Total length (feet)	Length Affected (%)
Buckskin Creek and tributary	0	4,118	0
Pat Hughes Creek and tributary	3,029	4,371	86
East Fork Pat Hughes Creek	0	3,971	0
No Name Creek	0	7,584	0
Bruno Creek, West Fork Bruno Creek, and tributaries	3,215	6,460	50
Mill Creek[1]	4,397	4,469	98
TOTAL	**10,641**	**30,973**	**34**

[1] Includes Mill Creek channel effects under Alternative M2 and during reclamation.

4.9.1.3. Alternative M3 – No Name Waste Rock Storage Facility

The type and area of wetlands affected would be nearly identical to Alternative M2, except for the inclusion of three additional wetlands due to the No Name WRSF: UN1 (PEM, 0.03 acre), UN2 (PEM, 0.02 acre), and UN Spring W1 (spring, 0.003 acre). There would be 3.44 acres of wetlands filled or buried in the analysis area (Table 4.9-3.), with effects to 74 percent of the jurisdictional wetlands in the analysis area (permanent, major effect). A total of 16,247 feet of the stream length designated as WUS in the analysis area (52 % of the stream length in the analysis area) would be buried by the WRSFs, inundated by the TSF, disturbed by relocation of the Pat Hughes sediment pond, or disturbed during reclamation (Table 4.9-4)(permanent, major effect). TCMC would implement a wetlands mitigation plan to mitigate these effects (Section 4.21., Appendix B).

Table 4.9-3. Effects to wetlands, Alternative M3.

Wetland ID	Affected[1] (acres)	Type[2]	JD[3] Status
PH Tributary Spring	0.05	PEM	Yes
PH1	0.21	PEM	Yes
BR2	0.032	PFO	Yes
UN1	0.03	PEM	Yes
UN2	0.02	PEM	Yes
UN Spring W1	0.003	Spring	Yes
WB1	0.025	PFO	Yes
WB2	0.108	PFO	Yes
WBWet1	0.004	PEM	Yes
WBWet2	0.003	PEM	Yes
Wetland1	0.036	PFO	Yes
MC1[4]	0.217	PEM	Yes
MC3[4]	0.21	PEM	Yes
MC4[4]	0.796	PEM	Yes
MC5[4]	0.127	PEM	Yes
MC6[4]	0.811	PEM	Yes
MC7[4]	0.153	PEM	Yes
MC8[4]	0.406	PEM	Yes
MC9[4]	0.203	PEM	Yes
MC Spring[4]	0.002	Spring	Yes
TOTAL	**3.44**		

[1] Due to the small size of the wetlands in the analysis area, if any portion of a wetland was in the analysis area the entire wetland was assumed to be affected (i.e. inundated, filled, or excavated).
[2] Cowardin et al. (1979)
[3] jurisdictional determination
[4] Mill Creek drainage wetlands that would be disturbed during reclamation.
BR = Bruno Creek; MC = Mill Creek; PH = Pat Hughes Creek; WB = West Fork Bruno Creek

Table 4.9-4. Effects to stream channels, Alternative M3.

Stream	Length Affected (feet)	Total Length (feet)	Length Affected (%)
Buckskin Creek and tributary	0	4,118	0
Pat Hughes Creek and tributary	3,029	4,371	86
East Fork Pat Hughes Creek	0	3,971	0
No Name Creek	5,606	7,584	74
Bruno Creek, West Fork Bruno Creek, and tributaries	3,215	6,460	50
Mill Creek[1]	4,397	4,469	98
TOTAL	**16,247**	**30,973**	**52**

[1] Includes Mill Creek channel effects under Alternative M2.

4.9.2. Land Disposal Alternatives

4.9.2.1. Alternative L1 – No Action

The 52 wetlands on the selected land (49.69 acres) would remain under Federal jurisdiction (Table 4.9-5). The 19 wetlands on the Broken Wing Ranch (36.98 acres) and the wetland on the Garden Creek property (0.7 acre) would remain in private ownership (Table 4.9-6).

4.9.2.2. Alternative L2 – Land Exchange Proposal

The wetlands on the selected land would be acquired by TCMC. Most (77 %; 38 acres) of the wetlands on the selected land would be within ⅛ mile of Thompson Creek and S. Creek, and could be only minimally disturbed due to the Thompson Creek and S. Creek Conservation Easement, and no actions which could materially affect the Thompson Creek or S. Creek riparian corridors are reasonably foreseeable, e.g., TCMC does not have any plans that would disturb any of the wetlands on the selected land (long-term, minor effects).

Table 4.9-5. Wetlands on the selected land, Alternative L2.

Jdx.	Wetlands[1]						TOTAL By Ownership	
	Palustrine Emergent (PEM)		Palustrine Shrub-Scrub (PSS)		Palustrine Forested (PFO)			
	(#)	(acres)	(#)	(acres)	(#)	(acres)	(#)	(acres)
BLM	30	5.81	19	40.04	3	3.84	**52**	**49.69**

[1] Cowardin et al. 1979

The wetlands on the offered lands would be acquired by the US: PEM (26.72 acres), PSS (9.57 acres), and PFO (1.39 acres) (Table 4.9-6). The BLM ranch management strategies would improve the riparian area adjacent to the Salmon River on the ranch by increasing the width of riparian vegetation (cottonwood, willow, forbs) with restoration and rest from grazing (long-term, moderate effect). There would be a net decrease of 12.01 acres of wetlands on BLM land. Under Alternative L2-B there would be no streambank trampling or damage to riparian vegetation from cattle at the gated Salmon River cattle crossing (long-term, minor effect).

Table 4.9-6. Wetlands on the offered lands, Alternative L2.

Jdx.	Wetlands[1]						TOTAL By Ownership	
	Palustrine Emergent (PEM)		Palustrine Shrub-Scrub (PSS)		Palustrine Forested (PFO)			
	(#)	(acres)	(#)	(acres)	(#)	(acres)	(#)	(acres)
Broken Wing Ranch	7	26.72	10	8.87	2	1.39	**19**	**36.98**
Garden Creek Property	0	0	1	0.70	0	0	**1**	**0.70**
TOTAL	**7**	**26.72**	**11**	**9.57**	**2**	**1.39**	**20**	**37.68**

[1] Cowardin et al. 1979

4.9.2.3. Alternative L3 – Land Sale

The same wetlands would leave Federal jurisdiction as for Alternative L2, but the US would not acquire the wetlands or riparian areas at the Broken Wing Ranch and Garden Creek property – a decrease of 49.69 acres of wetlands on BLM land. Riparian fencing and other riparian improvement/protection projects under the BLM ranch management strategies would not occur (long-term, moderate effect).

4.9.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The selected land would contain only 500 feet of S. Creek instead of 2,500 feet under Alternative L2 (Figure 2.2-1). There would be 50 wetlands (21.72 acres) on the selected land: PEM (5.81 acres), PSS (12.07 acres), and PFO (3.84 acres) (Table 4.9-7). Approximately 35 percent of the wetlands would be within ⅛ mile of Thompson Creek, and would be protected by the Thompson Creek and S. Creek Conservation Easement (long-term, minor effect). TCMC does not have any current plans that would disturb wetlands on the selected land.

Table 4.9-7. Wetlands on the selected land, Alternative L4.

	Wetlands[1]							
	Palustrine Emergent (PEM)		Palustrine Shrub-Scrub (PSS)		Palustrine Forested (PFO)		TOTAL	
Jdx.	(#)	(acres)	(#)	(acres)	(#)	(acres)	(#)	(acres)
BLM	30	5.81	17	12.07	3	3.84	**50**	**21.72**

[1] Cowardin et al. 1979

There would be 37.68 acres of wetlands on the offered lands (Table 4.9-6). If the US acquired all of the offered lands there would be a net gain of 15.96 acres of wetlands on BLM land. However, there would be varying amounts of wetlands on the ranch subparcels (Table 4.9-8.) or the Garden Creek property (0.7 acre) that would not be acquired by the US (long-term, negligible to moderate effects). For example, if BWR-1 was not acquired by the US, 21.46 acres of wetlands (58 % of all wetlands on the ranch) would remain in private ownership (long-term, moderate effect).

Table 4.9-8. Wetlands on the Broken Wing Ranch, Alternative L4.

Jdx.	Wetlands[1]						TOTAL[2]	
	Palustrine Emergent (PEM)		Palustrine Shrub-Scrub (PSS)		Palustrine Forested (PFO)			
BWR-1	ID	(acres)	ID	(acres)	ID	(acres)	(#)	(acres)
	1A	0.44	1	1.20	3	0.50	**8**	**21.46**
	2	15.72	9	0.05				
	2A	2.38						
	2B	0.77						
	2C	0.40						
BWR-2			4	0.04	3	0.25	**4**	**1.09**
			8	0.76	10	0.04		
BWR-3			11	0.01	3	0.25	**3**	**0.61**
					10	0.35		
BWR-4	6A	6.70	7A	0.70			**6**	**10.5**
	6B	0.31	7B	0.26				
			8	1.52				
			12	1.17				
BWR-5							**0**	**0**
BWR-6			8	1.26			**1**	**1.26**
BWR-7			5	1.41			**2**	**1.91**
			8	0.50				
TOTAL	**7**	**26.72**	**12**	**8.87**	**5**	**1.39**	**24**	**36.98**

[1] Cowardin et al (1979)
[2] Wetlands were counted more than once when they extended into another subparcel.

4.9.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The same wetlands on the selected land would leave Federal jurisdiction as for Alternative L2 and Alternative L3, except the wetlands (~ 0.5 acre) within a short length (2,500 feet) of the S. Creek riparian corridor and the wetlands (~ 0.16 acre) on the 1,500 acres. However, all of the wetlands on the selected land would be protected by the conservation easement on the 1,500 acres or the Thompson Creek and S. Creek Conservation Easement, except for the wetlands within ⅛ mile of the S. Creek riparian corridor on the selected land. However, there would be no subdivision/residential development in the S. Creek riparian corridor, and no actions which could materially affect the Thompson Creek and S. Creek riparian corridors on the selected land are reasonably foreseeable (negligible effect). Depending on the offered lands acquired by the US, the BLM would probably gain jurisdiction of most of the wetlands on the offered lands: slightly more than under Alternative L4, and slightly less than under Alternative L2 (37.68 acres, Table 4.9-6.) (long-term, minor effect).

4.10. Air Quality, Noise, and Climate Change

4.10.1. MMPO Alternatives

4.10.1.1. Alternative M1 – No Action

Air Quality

Air quality emission inventories and computer simulations from pollutant dispersion models demonstrate the maximum concentrations (including background concentrations) of criteria air pollutants at the perimeter of the mine would exceed SILs (minimal impact levels) for only PM_{10}, nitrogen dioxide and sulfur dioxide, but the maximum concentrations would reach only 60 percent of the NAAQS for PM_{10} and less than 17 percent of NAAQS for sulfur dioxide and nitrogen dioxide. The results also demonstrate that the concentrations of all criteria pollutants would be below the SILs at the Thompson Creek and S. Creek roads, and all areas of regular human activity (IDEQ 2008).

After mining, the amounts of mine-generated criteria air pollutants would decrease somewhat proportional to the decrease in workers during the reclamation stages. In addition, improved technology would be expected to continue to reduce pollutants from equipment emissions. Regardless, after core reclamation, the concentrations of pollutants would be essentially those of the background (no mining) condition, which would be less than those of the pre-mine condition (1980) due to improvements in technology to reduce these pollutants from industrial and vehicle emissions, the removal of lead and substantial decrease in sulfur from vehicle fuels, and the relatively small increase in non-mining vehicle emissions or other source emissions in the analysis area since 1980. The PM_{10} generated from the waste rock and TSF during mining, even without vegetation, would be comparable to or less than the pre-mine condition due to the relatively coarse materials. Once capped, the WRSFs would generate approximately 15 percent more annual PM_{10} compared to during mining, until vegetation was established during late-stage reclamation when the PM_{10} from wind erosion would be comparable to the pre-mine condition.

There would be no substantial quantities of criteria pollutants generated by off-site, mine-related vehicle traffic due to the relatively few vehicles involved, the relatively large areas in which the pollutants would be generated, and the relatively small quantities of generated pollutants. The largest quantity of pollutants would be from fugitive dust on the unpaved Thompson Creek and S. Creek roads. However, there would be very little mine-related traffic on Thompson Creek Road (Section 4.16.), and such traffic would be at very low speeds, e.g., less than 20 mph. The S. Creek Road has relatively low (~ 3 %) silt content from many years of use, and TCMC would continue to maintain the surface on the road with magnesium chloride. Therefore, the fugitive dust that would be generated from S. Creek Road during mining would probably be less than or comparable to the pre-mine condition, even considering the additional mine-related traffic. Regardless, people traveling on S. Creek and Thompson Creek roads may occasionally encounter a small, light-colored dust cloud from mine-related traffic. These clouds would be up to approximately 100 feet in diameter perpendicular to the roads, up to approximately 500 feet in length behind a vehicle, and would disperse within at most a minute or two, typically after traveling less than 500 feet. There would be no meaningful off-site fugitive dust.

There would be no meaningful effects to wildlife due to criteria pollutants in the analysis area, i.e., transient nature of most wildlife would result in less exposure to criteria pollutants than people working or living in the analysis area. There would be no potential for a substantial natural or human-caused wildfire at the mine during mining due to the lack of vegetation at the site and safety policies enforced at the mine. Despite fire prevention/suppression programs at the mine, there would continue to be a very slight probability of a substantial, human-caused wildfire near the mine (including on the selected land that is not part of the mine) due to operations near the perimeter of the mine in and adjacent to native vegetation cover, or due to non-TCMC personnel in the area. There would be a slight probability of a substantial (natural or human-caused) wildfire at the mine after revegetation from reclamation because of the decrease in workers and equipment available on-site for rapid fire suppression. The probability of such wildfire would be comparable to that on the selected land (that is not part of the mine) or that of pre-mine conditions.

Noise

Sound levels at the mine would continue to vary from about 35 dBA L_{DN} (e.g., at the edges of the operational area such at the north end of the TSF) to 105 dBA L_{DN} in certain noisy work areas (e.g., the operator position for the gyratory crusher). However, compliance with current mine safety procedures would ensure that TCMC employees or visitors to the mine would not be exposed to noise above regulatory limits.

The main sources of ambient sound in the analysis area would continue to be from wind, flowing water, birds and insects. Sound levels in the ambient portion of the analysis area would continue to be approximately 30 dBA L_{DN} in the quietest areas up to approximately 55 dBA L_{DN} in areas near flowing water or windy locations. Mine-generated sound might be heard by people or wildlife within approximately 1,000 feet (or only a few hundred feet when trees would be abundant) of the perimeter of the mine. In such case, these receptors may occasionally hear faint sounds from heavy equipment operating at the mine perimeter, e.g., a vehicle back-up warning signal in the Pat Hughes Creek drainage. All other human receptors would generally be shielded from mine-generated sound (and blasting vibrations) by intervening ridges and distance. For

example, people traveling on Thompson Creek Road would not hear WRSF activities in the Pat Hughes Creek drainage, and mine-generated sound would not be audible at residences in the analysis area, most of which would also be buffered by sound from nearby flowing water and non-mining vehicle traffic on nearby roads.

The increase in the sound level 50 feet from SH 75 from mine-related, highway traffic during molybdenum production would continue to be negligible (1.8 dBA). Mine-related sound would decrease somewhat proportional to the decrease in workers during the reclamation stages, and by late-stage reclamation would be at pre-mine levels, e.g., 30 to 55 dBA L_{DN}. Wildlife at or within 1,000 feet of the mine would experience mine-generated sound, but would not be meaningfully affected by such sound, e.g., deer commonly forage adjacent to highways, elk commonly graze at the mine, and a black bear has casually wandered into the pit; the transient nature of wildlife is such that wildlife would not remain at or near the mine if disturbed by noise. A more detailed evaluation of the potential effects to wildlife from mine-related noise is in the wildlife resources section (Section 4.7).

4.10.1.2. Alternative M2 – MMPO as Submitted by TCMC

The effects on air quality would be essentially the same, except that they would occur for 9 years longer and there would be an increase of 2.6 and 2.0 percent, respectively, of the annual PM_{10} and $PM_{2.5}$ generated from the additional area of TSF (82 acres) and WRSFs (252 acres) (TCMC 2012c). These increases would have negligible effects on the most sensitive human receptors. The ambient air analysis area would be the same because none of the proposed expansion would increase the restricted mine area. The probability of a mine-related wildfire would be comparable to that under Alternative M1.

Similar to air quality, the effects of noise would be essentially the same except would occur for a longer duration. The toe of the Pat Hughes WRSF would gradually extend an additional 1,400 feet south down the drainage. However, even at its farthest extension the toe would be 2,640 feet from Thompson Creek Road, and the closest equipment on the lowermost bench would be 3,990 feet from road. Therefore, even bulldozers with a maximum sound level of 87 dBA at 50 feet would not be audible to someone walking on Thompson Creek Road near the mouth of Pat Hughes Creek.

4.10.1.3. Alternative M3 – No Name Waste Rock Storage Facility

The effects on air quality and of noise would be essentially the same as under Alternative M1 and Alternative M2. The construction of a new WRSF (237.5 acres) in the No Name Creek drainage would generate approximately 26 tons of PM_{10} during construction activities lasting a few weeks. Thereafter, at its maximum size, the facility would generate approximately 20 tons of PM_{10} annually. These amounts of PM_{10} and $PM_{2.5}$ would not affect the most sensitive receptors. The increase in pollutants from equipment emissions during the construction of the facility would similarly be negligible. The same would be true for the decrease of approximately 5 to 10 percent in pollutants due to shorter, waste rock haul distances using the No Name facility compared to Alternative M2. The ambient air analysis area would also be reduced by 1.1 percent. The effects of noise would be essentially the same as Alternative M1 and Alternative M2. Sound from heavy equipment at the No Name facility would not be audible

along Thompson Creek Road, which would be a minimum of 1,600 feet from the toe of the final configuration of the No Name facility.

4.10.2. Land Disposal Alternatives

4.10.2.1. Alternative L1 – No Action

The ambient air quality of the analysis areas for the selected and offered lands would be within the NAAQSs for all criteria pollutants. The SILs for mine-generated PM_{10}, nitrogen dioxide, and sulfur dioxide would be exceeded at the selected land within the perimeter of the mine, but would not be exceeded in the vicinity of any sensitive receptors in the analysis area, or along S. Creek or Thompson Creek roads. Mine-generated pollutants and their effects to the most sensitive receptors (none at the selected land) would be the same as described for the MMPO alternatives. The offered lands would continue to have excellent air quality, with negligible emissions of fugitive dust at the Garden Creek property and emissions of fugitive dust at the Broken Wing Ranch typical of the agriculture and cattle ranches in the region, even if limited residential development were to occur.

Ambient sound levels in the analysis area for the Broken Wing Ranch would continue to be approximately 45 to 50 dBA and 35 dBA L_{DN} within 50 feet and 300 feet, respectively, of the highway, comparable to typical outdoor sound levels of 35 to 50 dBA L_{DN} for rural areas. Limited residential development at the ranch would not noticeably (> 3 dBA L_{DN}) increase the average sound level of the analysis area for the ranch.

Ambient sound levels in the analysis area for the Garden Creek property would be approximately 30 to 40 dBA L_{DN}. Vehicle traffic in the analysis area would be extremely rare. There would occasionally be air traffic over the property due to the small Pocatello airport approximately 10 miles to the north. Such overflights would have short-term effects up to approximately 60 dBA L_{DN} a few times per day. Limited residential development at the ranch would not noticeably increase the average sound level of the analysis area.

4.10.2.2. Alternative L2 – Land Exchange Proposal

There would not be increased sound levels and criteria pollutants from limited residential development (e.g., vehicle emissions and sound, fugitive dust from vehicles, wood stoves, typical residential sounds) that would probably occur under Alternative L1. However, there would be increased sound levels and pollutants from dispersed public recreation (e.g., emissions, sounds, and fugitive dust from vehicles; typical recreational sounds). No pollutants/sound would be generated from public vehicles in the drainage. However, the greater number (few hundred per year) of dispersed recreationalists would cause increased dust clouds from vehicle traffic on the main access road through the ranch, primarily during the summer when traffic would be greatest and the ground would be driest, and to a lesser extent during the fall hunting season. The dust clouds would be a few hundred feet in diameter, would disperse in less than 1 minute, and would not reach residences outside of the ranch. Similar dust clouds, but with a lower frequency and diameters up to approximately 1,000 feet, would continue to be generated during high winds from agricultural plowing (long-term, minor effects). There would be dust clouds that could reach adjacent property, particularly on windy days, if motorized use was allowed on the Challis East Subdivision Trail (long-term, minor effect for aesthetic reasons). However,

there would not be an increase in the concentrations of any criteria pollutant of more than its SIL at any residence in the analysis areas for the selected and offered lands (negligible effect).

There would not be an increase of 3 dBA L_{DN} or more in these analysis areas, except approximately within 25 feet of the main access road of the ranch (~ 3 to 6 dBA L_{DN}) during periods of greatest use, and within 50 feet of the ranch houses if the areas outside the houses were being used by a large group of people (~ 3 to 6 dBA L_{DN}). The development of a campground would cause a similar increase in sound level within approximately 100 feet of the campground (long-term, minor effects). The Challis East Subdivision Trail would cause an increase in sound levels (~ 3 to 10 dBA L_{DN}) at some of the adjacent properties if motorized use was allowed on the trail (long-term, minor to moderate effect). Under Alternative L2-B there would be a similar increase in sound level in the Lyon Creek drainage from vehicles (long-term, minor effect). After the initial plowing as part of the conversion to native vegetation, there would not be dust clouds from agricultural plowing (long-term, minor effect).

4.10.2.3. Alternative L3 – Land Sale

There would be the same effects as for Alternative L1.

4.10.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

There would be essentially the same effects as for Alternative L2 (long-term, negligible to minor effects).

4.10.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The conservation easement on approximately 1,500 acres of the selected land would preclude any meaningful increases in pollutants or sound from the area, but no such increases are reasonably foreseeable for the area. Therefore, the effects would be essentially the same as for Alternative L2 (long-term, negligible to minor effects).

4.10.3. Climate Change

There would not be any meaningful effects from the land disposal alternatives to climate change; therefore, only potential effects from the MMPO alternatives to climate change are discussed. The emissions of GHGs for the MMPO alternatives are compared to the emissions of Idaho, a portion of the Northern Rocky Mountains region, the US, and the world to provide an understanding of the relative amount of the emissions of the alternatives (Table 4.10-1).[6] However, the effects of the MMPO alternatives on climate change should be evaluated only by comparing the emissions of GHGs (as CO_2e) of the alternatives with the emissions of Idaho, the region, and the world, because certain GHGs have atmospheric lifetimes of years and are therefore well mixed and transported in the atmosphere.

[6] The CEQ (2010) has defined 0.025 MT/year of direct emissions of GHGs as a de minimis amount for the purposes of NEPA analysis.

Table 4.10-1. Summary of emissions of GHGs (MT CO_2e).

Area or Alt.	2009	2016	2017	2020	2025	2026	2027	2030	2035
M1	0.049	0.049	0.024	0.002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
M2	0.049	0.049	0.049	0.049	0.049	0.049	0.024	0.002	< 0.001
M3	0.049	0.049	0.049	0.049	0.049	0.049	0.024	0.002	< 0.001
Idaho[1]	38	41	41	43	45	46	46	48	51
Region[1]	135	159	163	175	197	202	206	221	249
US[2]	6,768	6,420	6,371	6,229	5,999	5,954	5,909	5,777	5,563
World[3]	57,811	62,727	63,463	65,722	69,455	70,227	71,007	73,400	77,569

[1] post-2009 estimated using the average annual increase projected during 2009 to 2020
[2] post- 2009 estimated using the average annual increase during 2000 to 2009
[3] post-2009 estimated by interpolation of the A2 emissions scenario (Nakićenović et al. 2000) with IPCC (2007) $GWPs_{100}$

4.10.3.1. Alternative M1 – No Action

The annual estimated emissions of GHGs of the mine during mining are and would continue to be 0.049 MT (Table 4.10-1.), which would be a negligible component of the world emissions of GHG. Direct emissions of GHGs would occur from the onsite TCMC vehicle fleet that would result from hauling and placing waste rock on Federal land, but these would not be substantial enough to cause an effect to climate change on any scale. During core reclamation there would be no emissions of GHGs from ore extraction, waste rock storage, ore processing, tailings storage, and shipments of ore to the Pennsylvania roasting plant. Emissions from stationary combustion (boilers) would also be reduced to only that from space heating. In addition, the emissions of GHGs from the onsite vehicle fleet, shipments to the mine, and commuter and contractor traffic would decrease by approximately 50 percent. Therefore, the emissions of GHGs of the mine would continue to a negligible component of Idaho, the region, US, and world emissions of GHGs during core, late-stage, and long-term reclamation (Table 4.10-1).

4.10.3.2. Alternative M2 – MMPO as Submitted by TCMC

The annual emissions of GHGs would be essentially the same as those under Alternative M1, except the emissions during mining would occur through 2025 instead of only 2016, followed by essentially the same emission patterns during reclamation as under Alternative M1 (Table 4.10-1).

4.10.3.3. Alternative M3 – No Name Waste Rock Storage Facility

The construction of an additional WRSF facility in the No Name Creek drainage would not cause any substantial changes to the annual emissions of GHGs from the mine as compared to Alternative M1 and Alternative M2. That is, there would be a negligible increase in the emissions of GHGs due to longer haul distances (Table 4.10-1).

4.10.3.4. Effects of Climate Change on the MMPO Alternatives

Regarding the potential effects of climate change on all of the alternatives, there are dozens of models that provide different, general, climate change scenarios for various emissions scenarios, e.g., the average annual precipitation worldwide or for a major region. However, none of the models may be scaled down to the spatial level of the mine site or even the region of the mine with a certainty that would allow meaningful evaluation of site-specific future effects due to climate change, or the evaluation of potential mitigation of such effect. In addition, the appropriate emissions scenario is unknown. In short, "Any study of climate change and its impacts at the regional scale is fraught with uncertainties" (Whetton et al. 1993, p. 291), and "specific, local outcomes of climate change are uncertain" (IPCC 2012, p. 29).

Assessing future extreme weather events is far more uncertain, e.g., "There is limited to medium evidence available to assess climate-driven observed changes in the magnitude and frequency of floods at regional scales because the available instrumental records of floods at gauge stations are limited in space and time, and because of confounding effects of changes in land use and engineering. Furthermore, there is low agreement in this evidence, and thus overall *low confidence* at the global scale regarding even the sign of these changes" and "It is *likely* [less than 66 %] that the frequency of heavy precipitation or the proportion of total rainfall from heavy rainfalls will increase in the 21st century over many areas of the globe. This is particularly the case in the high latitudes and tropical regions, and in winter in the northern mid-latitudes...For a range in emission scenarios (SRES A2, A1B, and B1), a 1-in-20 year annual maximum 24-hour precipitation rate is *likely* to become a 1-in-5 to 1-in-15 year event by the end of the 21st century in many regions..." (IPCC 2012, p. 112-113). In addition, the foremost authority on precipitation frequency analysis – the NOAA – conducts such analysis based on a stationary climate because 1) statistical tests to identify statistically significant trends in the annual maximum series of observations used in the frequency analysis do not show meaningful observable or geographically consistent temporal change in these data, and 2) the effect of potential changes in climate on precipitation frequency estimates is uncertain (NOAA 2013b).

Such general inferences from computer simulations may be used to guide further research or examine worst-case scenarios at the global or regional scale, but are far too speculative for use in site-specific engineering. Therefore, state-of-the-industry engineering is still based on historic climate records and not on computer climate simulations. For example, ports worldwide are currently designed for historic (typically 100 year) flood events (Becker et al. 2012), and water diversion ditches at the mine would not be designed with smaller capacities if climate simulations suggested less intense storms than historic records for the region.

It is difficult to assess the risk (probability and consequence) of uncertainties in climate change effects to the alternatives because the accuracy of the climate simulations of the models is unknown. For example, 100 year simulations for the western US from a selection of 21 regional climate models project an increase in average annual global temperature ranging from 2.1 °C (3.8 °F) to 5.7 °C (10.3 °F), and an average annual precipitation ranging from a *decrease* of 3 percent to an *increase* of 14 percent. These ranges were generated for a single, medium emissions scenario. Using some of the higher and lower emissions scenarios would have generated an even wider range of projected temperature and precipitation (Christensen et al. [IPCC] 2007). In addition, a recent evaluation for the last 15 years (1998 to

2012) of 117 simulations from 37 CMIP5 models yielded a trend of 0.21 °C (0.38 °F) ± 0.03 °C (0.05 °F) per decade, more than four times larger than the measured trend of 0.05 °C (0.09 °F) ± 0.08 °C (0.14 °F) per decade at the 95 percent (widest) confidence intervals (Fyfe et al. 2013). That is, the results of computer simulations are currently substantially different than measured values, even for the simplest parameter – global average surface temperature.

Regardless, increasing the average annual precipitation by 14 percent would not cause catastrophic failure of the pit walls, WRSFs, or the TSF, but increasing the annual temperature at the mine by 5.7 °C would cause long-term, major effects including dramatic changes in vegetation patterns and wildlife ranges. However, under such circumstances humans would probably be dealing with catastrophic famine and the collapse of societies. Regarding the uncertainty of extreme weather events, projections of climate change suggest increasing temperatures and intensified precipitation patterns across the US (Christensen et al. [IPCC] 2007; Kollat et al. 2012). These projections in a worst-case scenario suggest a 20 year/24 hour storm (5 % chance of occurrence in any year, 64 % chance of occurrence at least once in 20 years) could occur every 5 years (20 % chance of occurrence in any year, 99 % chance of occurrence at least once in 20 years) (IPCC 2012 – Figure SPM.4B., W. North America). Similarly, Kollat et al. (2012) infer a worst-case increase at the end of the 21st century of approximately 10 percent in 100 year flood discharges for the Northern Rocky Mountains, but caution that such inferences should not be considered as projections for specific regions or used to redraw flood maps.

Increased frequency of storms or an increase in the quantity of a 100 year flood discharge would be expected to cause proportional increases in erosion in all areas experiencing storms/floods, and in the frequency that the diversion ditches at the mine would not contain all flow. However, such increased surface run-off would not cause any catastrophic failures at the mine site, e.g., the reclaimed TSF would safely contain the 96 hour probable maximum precipitation for the site (substantially more than the run-off that would be generated in a 100 year storm event predicted by the historical record).

4.11. Visual (Aesthetic) Resources

4.11.1. MMPO Alternatives

4.11.1.1. Alternative M1 – No Action

There would be no new meaningful effects during mining or after reclamation (Photo 4.11-1., before reclamation). Therefore, the only effect to visual resources would be the continued mine lighting on dark night skies until 2016 (Section 4.11.2).



Photo 4.11-1. View from KOP 1, Alternative M1.

4.11.1.2. Alternative M2 – MMPO as Submitted by TCMC

The annual mining activity would be similar, but the incremental enlargement of the WRSFs and TSF might be noticeable from most of the KOPs (short-term effects). The overall enlargement would probably be noticeable from all of the KOPs (long-term effects).

KOP 1 – Custer Lookout

All of the disturbance that would be visible from KOP 1 would be on NFS land from the Upper Buckskin WRSF and the re-aligned power line (Photo 4.11-2., before reclamation). The Upper Buckskin WRSF would gradually expand on the north side of the mine. In the long term after mining, the disturbance (thin light tan or white line) would be widened and would have greater contrast with the surrounding dark greens and blues of the conifer forest. Observers who had seen the mine prior to Alternative M2, might notice the difference, but the effect would be minor from KOP 1. Changes over a few years would not generally be noticeable to the casual observer.

The re-aligned power line might be visible from KOP 1 as a faint diagonal line extending from the ridge behind the Buckskin WRSF down to the edge of the pit, and the removal of trees and shrubs along the power line corridor would create a color contrast with the surrounding conifer vegetation. The disturbance might be more noticeable in the short term just after construction (fresh disturbance and lack of understory vegetation). Once ground cover vegetation is re-established in the corridor, the corridor would be visible as a different color of vegetation, but might not be noticeable from KOP 1 considering the magnitude of the overall existing visual effects to the landscape of the mine. The NFS visible land from KOP 1 is designated VQO Modification. The BLM land visible from KOP 1 is designated VRM Class III (partial retention).

In the short term, the effect from KOP 1 would be a negligible, incremental change in the size of the WRSFs. Given the complex landscape surrounding the mine (multiple lines, variation in color and texture), the effect would be minor and long-term, and would meet the VQO Modification and VRM Class III designations. Reclamation of the WRSFs would reduce the contrast of the mine in the landscape from KOP 1.



Photo 4.11-2. View from KOP 1, simulation for Alternative M2.

KOP 2 – No Name Creek Drainage

There would be no effects from KOP 2 (Figure 4.11-1).

KOP 3 – South Butte

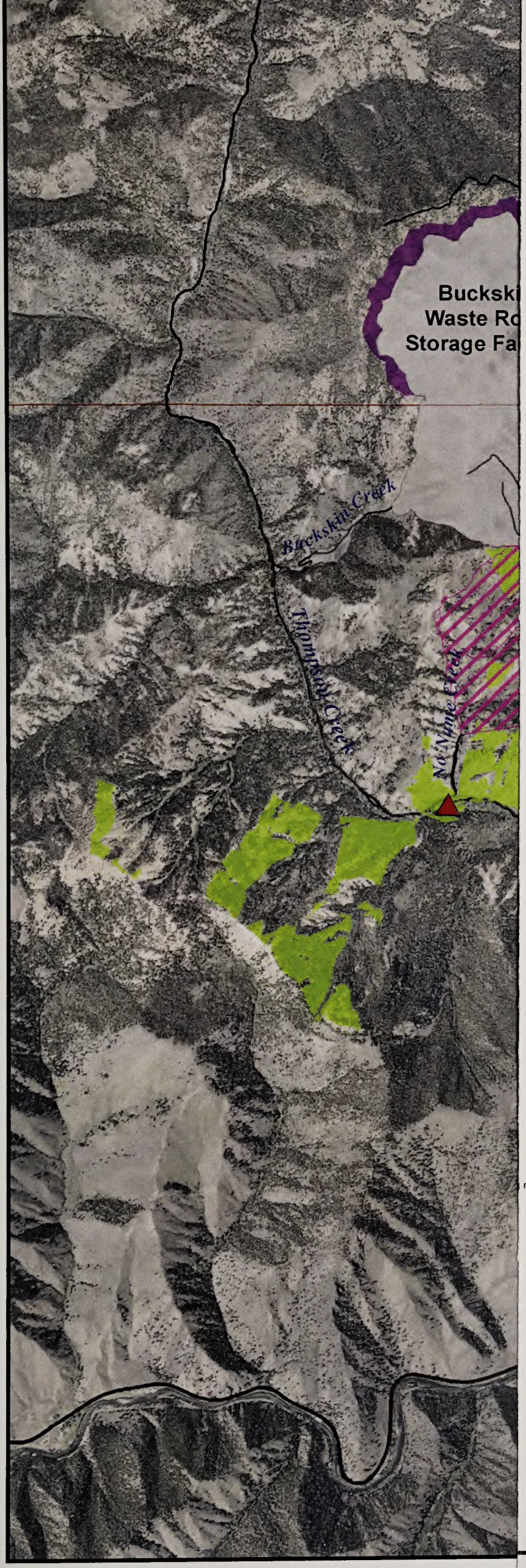
The majority of the existing TSF occurs on NFS land designated as VQO Modification. A small portion of the southwest corner of the existing facility occurs on BLM land designated VRM Class III. The disturbance from the TSF would affect both NFS and BLM lands (Photo 4.11-3., Photo 4.11-4., both before reclamation).



Photo 4.11-3. View from KOP 3, Alternative M1.



Photo 4.11-4. View from KOP 3, simulation for Alternative M2.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Stream
- 2WD road
- Primitive road
- KOP 2
- Visible from KOP 2

N

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Miles

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Kilometers

mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Viwshed Analysis by Connie Pixton, JBR Environmental Consultants, Inc.
Imagery NAIP 2009
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 4.11-1
2, No Name Creek drainage viewshed analysis
Thompson Creek Mine EIS

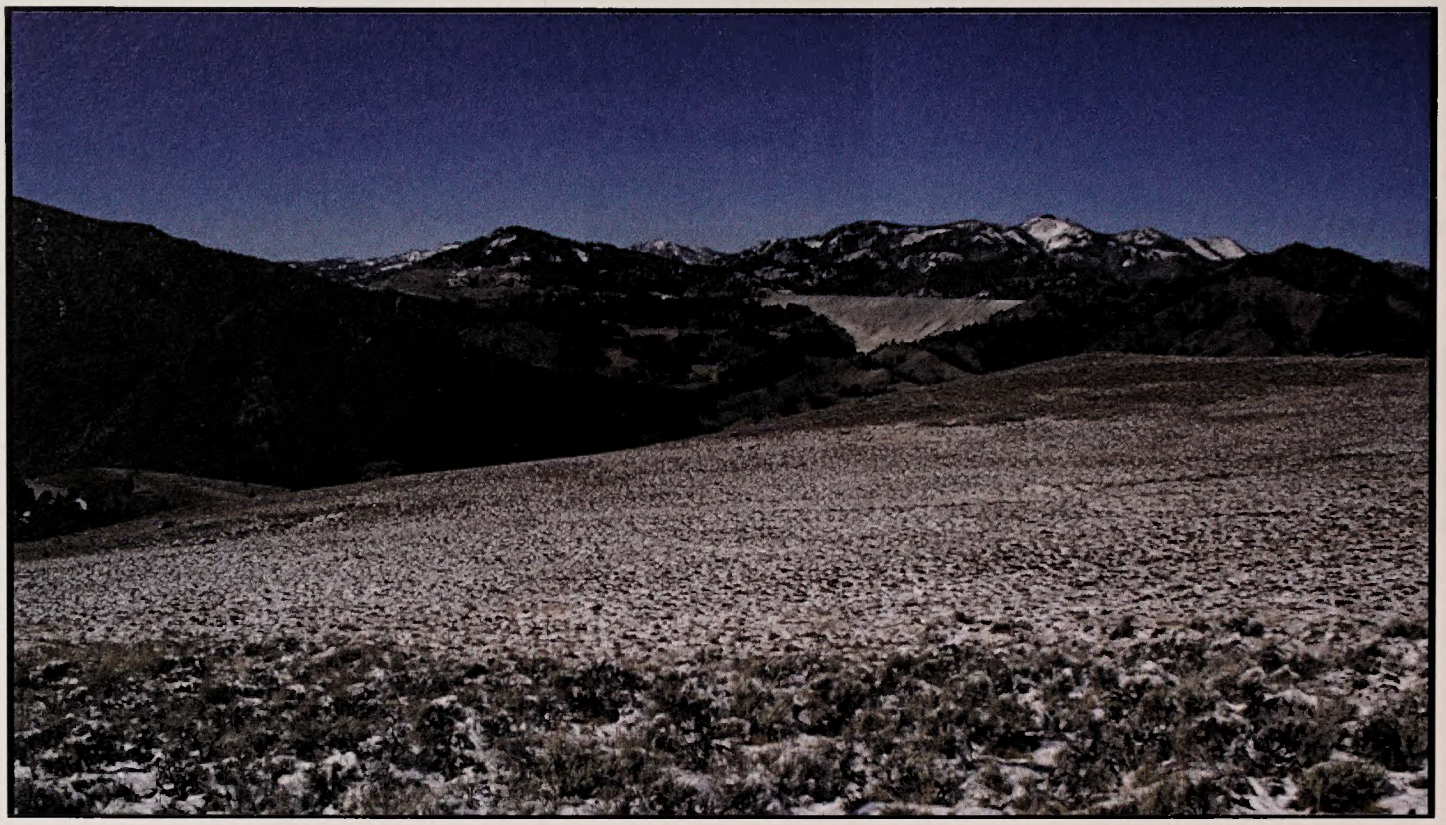
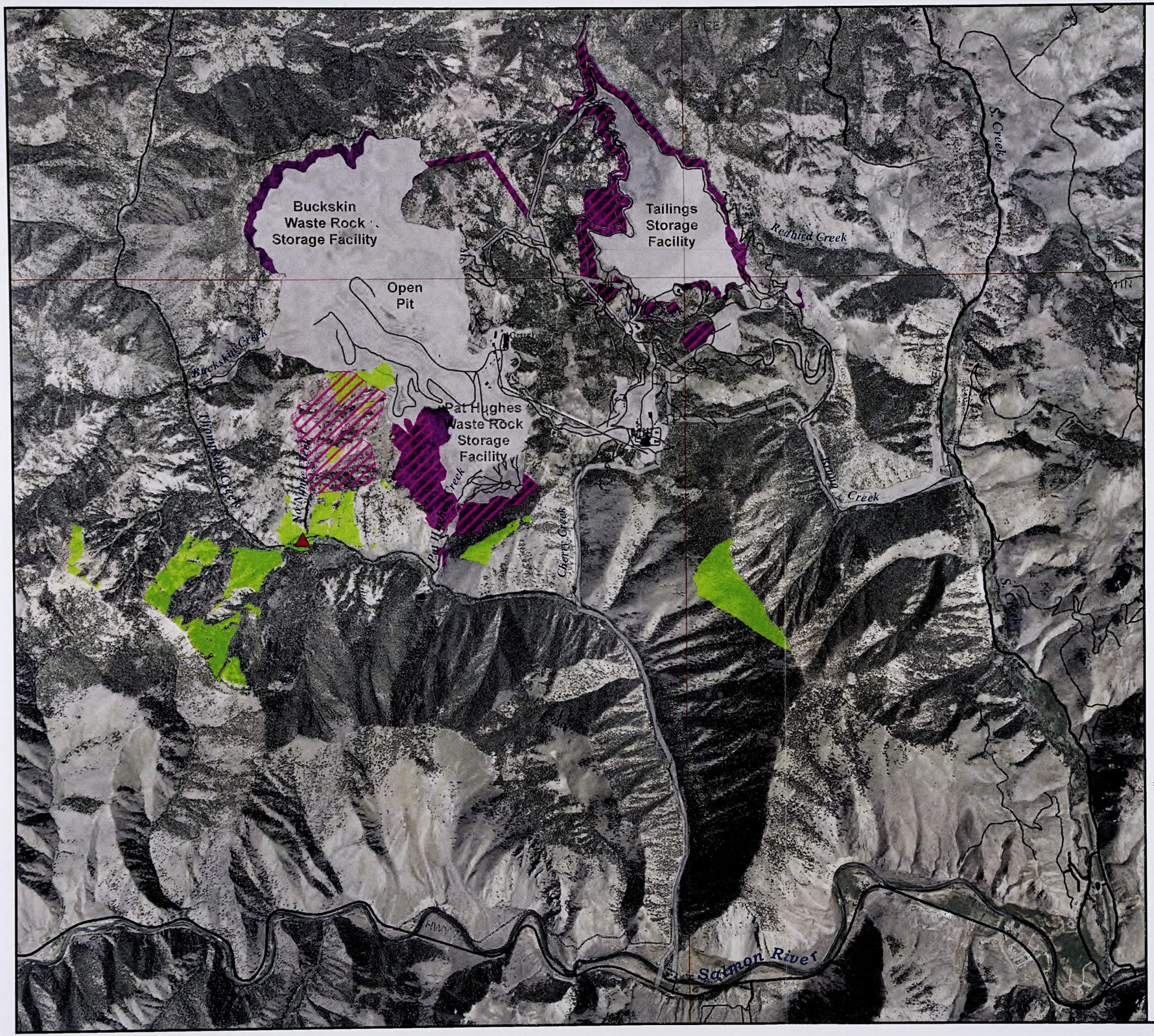


Photo 4.11-3. View from KOP 3, Alternative M1.



Photo 4.11-4. View from KOP 3, simulation for Alternative M2.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- MMPO areas/Alternative M3
- Stream
- 2WD road
- Primitive road
- KOP 2
- Visible from KOP 2

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Kilometers

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Viewshed Analysis by Connie Pixton, JBR Environmental Consultants, Inc.
Imagery NAIP 2009
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 4.11-1
KOP 2, No Name Creek drainage viewshed analysis
Thompson Creek Mine EIS

Under Alternative M1 the TSF embankment would be conspicuous in the landscape (Photo 4.11-3., before reclamation). The light tan to pale gray color of the embankment face would contrast distinctly with the brown to dark green, almost black, vegetated mountain slopes. Under Alternative M2 there would be a larger area of light color in the midst of the darker colors (Photo 4.11-4., before reclamation). The horizontal line at the top of the embankment would be slightly lengthened and the increased height of the face of the embankment would be somewhat noticeable, largely because of the color contrast. The changes in the embankment would possibly be noticeable to viewers familiar with the landscape from KOP 3, but would not essentially change the visual relationship between the embankment and the landscape. The changes would also occur during a number of years, reducing the noticeability of the changes to the casual observer. In the short term, effects to visual resources from KOP 3 would be negligible due to the relatively small, incremental change in the size of the TSF. At the end of mining, there would be a long-term, minor effect from the facility, but the VQO Modification and VRM Class III designations would be met (the TSF would not dominate the view).

Reclamation would include recontouring the embankment to create benches every 100 feet in vertical elevation, covering the face with growth media, and revegetating. Ultimately mature vegetation similar to that of the surrounding area would help reduce the contrast of the embankment face in the landscape from KOP 3, but the embankment would still be expected to be readily seen by the casual observer from the KOP.

KOP 4 – Highway 75

A viewshed analysis of KOP 4 representing views from SH 75 shows that the mine would not be visible under Alternative M1 or Alternative M2 from KOP 4 (Figure 4.11-2.), i.e., there would be no effect to visual resources from KOP 4.

KOP 5 – Railroad Ridge

All of the effects from KOP 5 would be on NFS land due to expansion of the Upper Buckskin WRSF and a portion of the TSF (Photo 4.11-5., Photo 4.11-6., both before reclamation). The areas of the facilities are designated VQO Modification.



Photo 4.11-5. View from KOP 5, Alternative M1.



Photo 4.11-6. View from KOP 5, simulation for Alternative M2.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- Stream
- 2WD road
- Primitive road
- Trail

Viewshed Analysis

- KOP 4
- Visible from KOP 4

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Miles

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Kilometers

mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Viwshed Analysis by Connie Pixton, JBR Environmental Consultants, Inc.
Imagery NAIP 2009
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

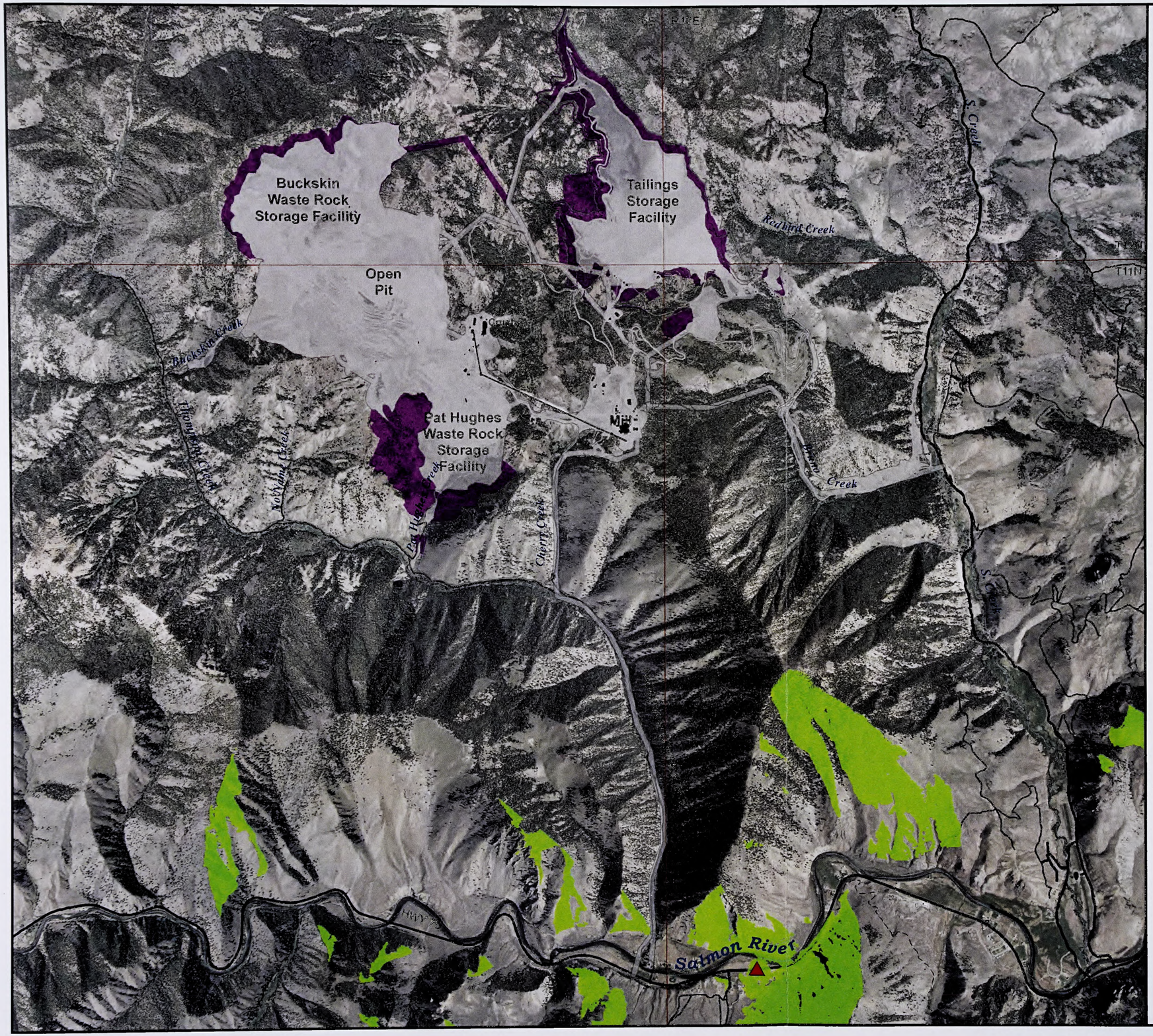
Figure 4.11-2
KOP 4, Highway 75 viewshed analysis
Thompson Creek Mine EIS



Photo 4.11-5. View from KOP 5, Alternative M1.



Photo 4.11-6. View from KOP 5, simulation for Alternative M2.



Legend

- Existing mining disturbance
- MMPO areas/Alternative M2
- Stream
- 2WD road
- Primitive road
- Trail

Viewshed Analysis

- KOP 4
- Visible from KOP 4

N

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Miles

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Kilometers

Selected land, existing mining disturbance, and Phase 8 expansion areas from Thompson Creek Mine data, polygons created by Ken Gardner.
Viwshed Analysis by Connie Pixton, JBR Environmental Consultants, Inc.
Imagery NAIP 2009
Coordinate system UTM Zone 11 NAD 83

No warranty is made by the Bureau of Land Management (BLM) for the use of this data for purposes not intended by the BLM.

Figure 4.11-2
KOP 4, Highway 75 viewshed analysis
Thompson Creek Mine EIS

The only mine features that would be visible from KOP 5 under Alternative M1 would be a portion of the pit, the Upper Buckskin WRSF and a portion of the top of the TSF; topography blocks views of the remainder of the mine development (Photo 4.11-5., before reclamation).

The majority of the effects from KOP 5 would be from the Upper Buckskin WRSF, with an expanded area of light tans and browns which would somewhat increase the appearance of the size of the mine in the landscape. The TSF embankment would be less conspicuous and barely noticeable in the landscape as the colors of the embankment face would be of similar scale and color to the surrounding patchy landscape. The expansion of the TSF would occur in very small increments over a number of years, which would reduce the noticeability of the change to the casual observer. In the short term, the effects from KOP 5 would be a negligible incremental change in the size of the mine surface disturbance. In the long term, there would be minor effects from the Upper Buckskin WRSF and TSF embankment. However, the area would continue to meet the VQO Modification designation as the perceptible visual changes would be minor.

Revegetation of the WRSF would soften the appearance of the topography and blend with the surrounding vegetation as viewed from KOP 5. At full maturity, revegetation of the facility would greatly reduce the effect from KOP 5, and might even prevent the embankment face from being seen from KOP 5. The portion of the uppermost pit visible would remain visible after reclamation.

KOP 6 – Pat Hughes Waste Rock Storage Facility

The effects from KOP 6 would be on BLM land due to expansion of the Pat Hughes WRSF (Photo 4.11-7., Photo 4.11-8., both before reclamation). The facility is on land designated VRM Class II and III, but the expansion of the facility would be on land mostly designated VRM Class II.

The light yellow-white to tan and gray colors of the facility would distinctly contrast with the surrounding darker land and vegetation. The texture of the waste rock would be somewhat coarse, but distinctly less coarse than that of the surrounding vegetation. The facility would expand in three dimensions making it appear taller, wider, and closer to the viewer. The area of light-colored waste rock would distinctly contrast with the surrounding darker colors. The horizontal line at the top of the facility would be lengthened to dominate the more subtle diagonal lines of the slopes of the enclosed landscape. The horizontal line would also be highlighted due to a second horizonal line where the foreground meets the gentle slopes of the middle ground. Rough, creased land forms in the background would be obliterated or obscured with greater uniformity to the view. Because the face of the facility would be closer to the viewer, more texture would be visible on the face than under Alternative M1. After mining the level of change to the landscape from the facility would be moderate and long-term; the activity would clearly attract the attention of the viewer with facility dominating the landscape from KOP 6.



Photo 4.11-7. View from KOP 6, Alternative M1.



Photo 4.11-8. View from KOP 6, with simulation of the Pat Hughes WRSF.

In the short term, effects from KOP 6 would be minor incremental changes in the size of the WRSF. After mining there would be a long-term, moderate to major effect from the facility from KOP 6. There would be a moderate change to the landscape compared to Alternative M1, which would not meet VRM Class II. However, KOP 6 is the only point along Thompson Creek Road from which a major feature of the mine can be seen, and the view from the KOP is exceptionally close to the mine.

4.11.1.3. Alternative M3 – No Name Waste Rock Storage Facility

The effects from the KOPs from the Buckskin and Pat Hughes WRSFs would be essentially the same as under Alternative M2, except for the development of the No Name WRSF on BLM land. Approximately half of the BLM land is designated VRM Class II and the other half is designated VRM Class III. Of the KOPs, only the view from KOP 2 would be affected (Photo 4.11-9., Photo 4.11-10., both before reclamation).

The No Name WRSF would be visible for a short distance, approximately a few hundred feet, for travelers going east or west on Thompson Creek Road. The facility would be upslope, 0.3 mile from KOP 2 and would introduce a new landform that would be the shape of an inverted pyramid. The waste rock would be mottled shades of tan, light brown, with grays and some yellow to white. The medium-textured waste rock would distinctly contrast with the relatively coarsely textured surrounding vegetation. The facility would block the view of (and cover) the rock outcrops near the horizon in the background, simplifying the landscape. Simplification of the landscape removes dynamic interest and focuses the attention of the viewer on the unnatural facility. The facility would distinctly attract the viewer's attention, particularly if active rock placement in the facility were visible from the KOP.



Photo 4.11-9. View from KOP 2, Alternative M1.



Photo 4.11-10. View from KOP 2, simulation for Alternative M3.

In the short term, while the facility would be developed, no or very little activity would be visible and there would be no or negligible effects from KOP 2. After mining there would be a long-term, major effect as the facility would be a major change to the landscape with an obviously human-made feature in distinct contrast with the surrounding land form, color, and texture. The VRM Class II designation would not be met. However, after reclamation (e.g., planting additional trees in the open spaces around the KOP to partially block or break up the view) the facility would not dominate the view.

4.11.2. Mine Lighting and Dark Night Skies (MMPO Alternatives)

Under Alternative M1 the levels of nighttime equipment operation and lighting would continue to affect dark night skies until approximately 2016. Subsequent reclamation would reduce the effects (illuminated mining activities) to dark night skies. After completion of core reclamation (~ 2020) there would be few or no remaining lights and little or no residual effects to dark night skies. Under Alternative M2 there would be essentially the same effects to dark night skies as under Alternative M1, both before and after reclamation, except the effects would continue until approximately 2030 instead of approximately 2020 (the end of core reclamation) (short-term, minor effect). Under Alternative M3 there would be vehicle lights visible from a new area of the mine at night, but overall effects to dark night skies would be similar to those under Alternative M1 and Alternative M2.

4.11.3. Land Disposal Alternatives

4.11.3.1. Alternative L1 – No Action

There would probably be no major changes to the visual resources of the selected land or offered lands in the short term. However, in the long term the offered lands may have new (Garden Creek property) or additional development (Broken Wing Ranch) with unknown effects to visual resources. As private land, the offered lands have no VQO or VRM designations.

4.11.3.2. Alternative L2 – Land Exchange Proposal

There would be no effects to the visual resources of the selected land other than those resulting from the mine (Section 4.11.1). There would be no effects to the visual resources of the Garden Creek property. Sensitive viewers of the ranch would be travelers on SH 75 and nearby residents. Viewers who frequently travel SH 75 and nearby residents would be more sensitive to the visible changes in land use. No distinct changes to visual resources would occur in areas that would continue in agriculture (BWR-2 and BWR-5, and portions of BWR-4 and BWR-6). However, people familiar with the ranch may notice fewer cattle along the riparian corridors, and there would be increased numbers of people and vehicles at the ranch, particularly driving through the ranch to access the Lyon Creek drainage or sections of the Salmon River. Groups of people may attract the attention of viewers in the area, as well as camping trailers and gear, such as tents which are frequently brightly colored in contrast to the natural surroundings (long-term, minor effect).

Subparcel BWR-1 would have more riparian vegetation (long-term, minor effect) due to a less pastoral or agricultural setting and vegetation that appears more natural (due to reduced grazing). There would probably not be any meaningful effects from the two private parcels which already have buildings and are occupied by people and vehicles. Facilities such as kiosks and restrooms

(e.g., interpretive sites on BWR-6 or a developed recreational facility on BWR-4) would be designed to blend with the natural surroundings, individually the lines and form of the facilities would be a minor, long-term change in the landscape. There would probably be long-term, moderate effects from developing a campground, e.g., concentrated human activity, lights visible at night including from campfires. However, the effects to dark night skies would be localized and minimal. People using the Challis East Subdivision Trail would at times attract the attention of people on the adjacent properties, particularly if motorized use was allowed or flashlights or headlights were used at night (long-term, minor effect).

Under Alternative L2-B, in the short term, there would be no cattle at the ranch but agricultural activity (e.g., tractors and irrigation) would continue and the fields would change from cultivated fields (brown when plowed, green during the growing season, and yellow during the non-growing season) to brown fields with sparse sagebrush and grasses (major effect). In the long term the fields would gradually change to yellow brown sagebrush steppe (sagebrush grasslands), there would be no cattle, and the irrigation equipment would be removed (long-term, major effect).

4.11.3.3. Alternative L3 – Land Sale

There would be the same effects as under Alternative L1.

4.11.3.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

There would be the same effects to approximately 3,600 acres of selected land as for Alternative L1. The effects to the offered lands would be the same as for Alternative L2 for the portions of the ranch and Garden Creek property acquired by the US, and the same as under Alternative L1 for those portions of the ranch or the Garden Creek property not acquired by the US.

4.11.3.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects to the selected and offered lands would be the same as those described for Alternative L4. Note that although the easement would protect approximately 1,500 acres of selected land from most potential effects to visual resources, the potential effects after post-mining if the easement were not in place are not reasonably foreseeable.

4.12. Land Use and Recreation

4.12.1. MMPO Alternatives

4.12.1.1. Alternative M1 – No Action

Multiple-use (primarily mining, grazing, and limited dispersed recreation) would continue as it has in the past and would be consistent with BLM and Forest Service land management plans. There would be no change in land jurisdictions. There would be no change to the BLM RMS classification of Middle Country for the MMPO because the existing operational area is also in the Middle Country classification. The NFS land in the MMPO would remain under the Rural ROS classification. There would not be any recreational access points, recreation areas, access roads, or trails closed due to the mine. There would not be any development or encroachment

into the S. Creek IRA. Users of this IRA would not experience any different conditions from those currently experienced due to the mine. There would not be any effects to SMAs.

The current recreational opportunities and land use would continue until mining ceases (~ 2016) and late-stage reclamation was completed (~ 2025). Land management plans have changed since the 1980 FEIS (USFS 1980), but the overall management principles have remained similar and would remain similar in the foreseeable future.

4.12.1.2. Alternative M2 – MMPO as Submitted by TCMC

Land Jurisdiction

There would be no change in land jurisdictions.

Land Use

Mining would continue with 497 acres changing from generally undeveloped forest to land disturbed by the mine. The change would affect only 0.01 percent of the land in Custer County, but would affect all of the MMPO area (long-term, major effect). The TCMC ROWs involving only the selected land would be relinquished (e.g., the exclusive easements for the Bruno Creek, Pat Hughes, and Buckskin roads). The TCMC ROWs involving some but not all of the selected land (e.g., the Cherry Creek road) would be modified to exclude those portions.

Special Management Areas

A total of 200.1 acres (0.03 %) of the Challis ERMA would be developed with mine facilities (negligible effect). There would be no effects to SMAs, and no disturbance in the S. Creek IRA. Users of this IRA would not experience any different conditions compared to under Alternative M1.

Recreation

There would not be recreational opportunities on 200.1 acres of BLM land and 185.5 acres of NFS land. The remainder of the analysis area (110.0 acres) is TCMC land for which recreational access would not change, e.g., TCMC employees would not be allowed to recreate on this land. There would be no change to the BLM RMS classification of Middle Country for the MMPO because the current mine operations are in the Middle Country classification. The NFS land in the MMPO area would continue to be classified as Rural ROS. There would not be any recreational access points, recreation areas, access roads, or trails closed due to the mine. However, the analysis area would not offer high quality recreation opportunities due to its proximity to the mine, and the decreased area available for recreation would be relatively small (negligible effects).

4.12.1.3. Alternative M3 – No Name Waste Rock Storage Facility

Land Jurisdiction

There would be no change to land jurisdictions.

Land Use

The effects would be similar to those under Alternative M2, but less of the Pat Hughes Creek drainage and no additional Buckskin Creek drainage would be disturbed. The No Name Creek drainage would change from undeveloped and forested to a WRSF (47 % more land converted than under Alternative M2) (long-term, major effect).

Special Management Areas

A total of 417.9 acres (0.06 %) of the Challis ERMA would be developed with mine facilities compared to 200.1 acres (0.03 %) of the ERMA for Alternative M2 (negligible effect).

Recreation

Over twice as much recreational access would be lost on BLM land than under Alternative M2, but such effects would still be negligible.

4.12.2. Land Disposal Alternatives

4.12.2.1. Alternative L1 – No Action

There would be no decrease in Federal land in the BLM Challis Field Office area, or increase in Federal land in the BLM Pocatello Field Office area. The selected land would remain forested land around a large mine administered the BLM. The BLM does not have plans to harvest timber or develop any new recreation facilities (e.g., trails or campgrounds) at the selected land. One commercial outfitter would continue to hunt on the selected land under a BLM special recreation permit. The BLM ranch management strategies would not be implemented. Development at the Garden Creek property and additional development at the ranch would probably occur in the foreseeable future. In particular, there would be a moderate probability that portions of the ranch frontage along 4.4 miles of the Salmon River and 0.9 miles of Lyon Creek would be sold in the foreseeable future for development/recreational use. Federal land would not be consolidated in the localities of the ranch or the Garden Creek property.

4.12.2.2. Alternative L2 – Land Exchange Proposal

Land Jurisdiction

The selected land (~ 5,100 acres) would become privately owned, and the offered lands (813 acres less 5 acres donated to Custer County by TCMC) in the BLM Challis Field Office area would be transferred to the US under BLM administration – a net decrease of approximately 4,300 acres of Federal land in the BLM Challis Field Office area. In Custer County there would be a negligible decrease in Federal land (93.2 to 93.0 %), a negligible increase in private land (5.0 to 5.2 %), and a negligible increase in county land (0.0730 % to 0.0731 %). In the BLM Pocatello Field Office area there would be an increase of 82 acres of Federal land in Bannock County (negligible effect).

Land Use

Most of the selected land (96 %) would remain forested and undeveloped (negligible effect). The BLM special recreation permit for one commercial outfitter would be modified to exclude the selected land. However, the outfitter would have access to commercially guide on the areas of the selected land currently used for hunting under the Access Yes program (with motorized access to Thompson Creek Road), and the State of Idaho no longer requires outfitters to be licensed to operate on private property (long-term negligible to minor effect).

The Broken Wing Ranch would be managed according to the BLM ranch management strategies under Alternative L2 or Alternative L2-B. The two parcels that would be donated to Custer County would be used for the benefit of the county such as educational purposes (e.g., partnership with an institution such as Boise State University for a geologic summer field camp), county business, or sold to raise revenue for the county (long-term, moderate effects). Acquisition of the ranch by the US would allow the BLM to create cooperation and partnerships to reconnect large landscapes to enhance water quality and protect fish and wildlife habitat by implementing standards and management practices that would complement the surrounding BLM lands. The ranch would not be further subdivided and developed along the Salmon River or Lyon Creek (e.g., Photo 4.12-1., Photo 4.12-2) (long-term, moderate effect). The use of the ranch by the public would slightly increase the probability of wildfire at the ranch (negligible effect).



Photo 4.12-1. New residential development along the Salmon River.
Land formerly part of the Broken Wing Ranch, October 2008, view to east.



Photo 4.12-2. Gravel pit.
Land formerly part of the Broken Wing Ranch, November 2012, view to southwest.

The non-irrigated, unfenced areas (~ 360 acres)[7] of the ranch are currently grazed by cattle from the BLM Bald Mountain and Split Hoof grazing allotments. These unfenced areas of the ranch would be incorporated[8] into the Bald Mountain Allotment to the east (an increase of ~ 275 acres or 1.7 % and an increase of ~ 7 AUMs or 1.6 %), and the Split Hoof Allotment to the west (an increase of ~ 90 acres or 1.1 % and an increase of ~ 2 AUMs or 1.1 %)[9] (long-term, minor effect).

Overall there would be a long-term, moderate effect to land use on the ranch, but a negligible effect on agricultural land use as a whole in Custer County. Under Alternative L2-B there would be a long-term, major effect on land use (i.e., conversion of the ranch to native vegetation and no livestock grazing). Under either ranch management strategy the three pivots would be allowed to irrigate their full perimeters, i.e., a few acres of BLM land adjacent to the ranch would be irrigated (the areas are not currently irrigated). The Garden Creek property would probably be

[7] 813 acres on ranch subparcels; 424 acres cultivated; 389 acres rangeland - 20 acres disturbed - 6.8 acres riparian shrubland = 362 acres rangeland

[8] by land use plan maintenance extending the existing BLM administration of the adjacent BLM land (allotments) to the relevant portions of the acquired land (ranch) as opposed to a land use plan amendment

[9] assume equal surface disturbance and riparian shrubland (13.4 acres) on rangeland on ranch adjacent to Bald Mountain and Split Hoof allotments; Bald Mountain allotment = 388.99 acres -13.4 acres - 102.42 acres for Split Hoof allotment = 273.2 acres; 273.2 acres / 37.2 acres/AUM = 7.3 AUMs; Split Hoof = 89.1 acres / 45.6 acres/AUM = 2.0 AUMs

administratively incorporated into the Old Tom Allotment, for an increase of 15 percent in the available AUMs for the allotment (long-term, moderate effect).

Special Management Areas

There would be a decrease of approximately 4,300 acres (0.7 %) of Federal land in the Challis ERMA (negligible effect). There would be an increase of 813 acres (1.9 %) of Federal land in the Upper Salmon River SRMA, which would help the BLM meet the objectives of the SRMA, e.g., protecting and enhancing recreational opportunities in the BLM Challis Field Office area. The BLM has recommended recreation improvements on the ranch that would increase access to the Salmon River and enhance camping opportunities in the BLM Challis Field Office area (Table 2.2.1.) (negligible effect). Although the portion of the river that runs through the ranch is not designated Wild and Scenic, there would be improved recreational access to portions of the river that are eligible for Wild and Scenic designation/recreational classification (long-term, minor to moderate effect). Such change in access and the quality of recreation would be noticeable to most individuals currently recreating in the area (long-term, moderate effect). Although the Challis Wild Horse and Burro HMA is adjacent to the ranch, there would be no effects to the HMA except for the inclusion of the portions of BWR-5 into the HMA (i.e., all BLM land east of SH 75) (negligible effect). There would be an increase of 82 acres (0.01 %) of Federal land in the Pocatello ERMA (negligible effect).

Recreation

There would not be any trails, campgrounds, or other developed recreation sites at the selected land, and TCMC does not propose any such improvements. TCMC would pursue a donated Access Yes agreement through the IDFG to allow hunter/angler access with the exception of the selected land that drains into Bruno Creek, Buckskin Creek, Pat Hughes Creek, and Cherry Creek (Figure 2.2-8.) (negligible effects, especially considering the scarce public use of the selected land in the past). The existing public access along the upper Thompson Creek Road would be retained by the BLM. The public would continue to be able access the Upper Thompson Creek Road by the Forest Service Road #040 ("North Slate Creek Bridge Road"); the Forest Service has an easement from TCMC for public access for the portion of the road which passes through TCMC property (no effect).

Portions of the Broken Wing Ranch could be developed with recreational facilities (Section 2.2.2.) improving the recreational opportunities in Custer County. The ranch would be under the BLM RSM classification of Rural: land within ½ mile of paved or primary roads with a landscape that has been considerably modified by agriculture, residential, or industrial uses. The classification includes facilities such as boat launches and campgrounds, and sounds of people can frequently be heard. Such change in access and the quality of recreation would be noticeable to most individuals currently recreating in the area (long-term, moderate effects). Under Alternative L2-B there would be the same fence array, but people would have year-round use of the converted area and there would not be people-cattle conflicts, or cattle manure (long-term, minor effect).

There are no specific management objectives planned by the BLM for the Garden Creek property, but the parcel would be open to non-motorized public recreation, including hiking, camping, and hunting. The BLM does not apply RSM classifications in the Pocatello Field

Office, so there would not be a RSM classification for the Garden Creek property. Acquiring the Garden Creek property would consolidate Federal land jurisdiction around the Garden Creek property, and make it easier for the public to recreate by not having to keep track of property lines (long-term, minor effect).

4.12.2.3. Alternative L3 – Land Sale

Land Jurisdiction

There would be a decrease of approximately 5,100 acres of BLM land in the Challis Field Office area, which would result in a small decrease in the Federal land in Custer County (93.2 % to 93.0 %), and a small increase in the private lands in the county (5.03 % to 5.19 %) (long-term, minor effects). The BLM would no longer administer approximately 500 mining claims, two ROWs, and portions of several easements associated with the selected land.

Land Use

There would be the same effects related to the selected land as under Alternative M2. There would be the same effects related to the offered lands as under Alternative L1.

Special Management Areas

There would be essentially the same effects to SMAs as under Alternative L2.

Recreation

The recreation opportunities on the selected land would be the same as under Alternative L2.

4.12.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

Land Jurisdiction

Compared to Alternative L1 there would be a decrease of BLM land in the Challis Field Office area: approximately 3,600 acres less approximately 550 acres of the Broken Wing Ranch that would be acquired by the US. Such would result in a small decrease in the Federal land in Custer County (93.2 % to 93.1 %), and a small increase in the private lands in the county (5.03 % to 5.05 %) (long-term, minor effects). The effects related to the Garden Creek property would be negligible, regardless of whether the property was acquired by the US or not.

Land Use

The selected land would be managed the same as under Alternative L2, except the S. Creek Road easement would be for only a short length of the road and much of the area that could be accessed by the public would be accessible as Federal land and not private land under the Access Yes Program. Compared to Alternative L1 the land uses would not change for all of the ranch subparcels and/or the Garden Creek property that would be eliminated from the land exchange.

Special Management Areas

The area of Federal land in the Challis ERMA would decrease by approximately 3,050 acres (3,600 acres less 550 acres), or 0.4 percent (negligible effect) compared to Alternative L1. Depending on how much of the ranch would be removed from the exchange, there would be an

increase of up to 813 acres of Federal land in the Upper Salmon River SRMA (negligible effect). Unless the Garden Creek property was removed from the exchange, there would be an increase of 82 acres (0.01 %) of Federal land in the Pocatello ERMA (negligible effect).

Recreation

Recreation opportunities on the selected land would be the same under Alternative L2, except the public could access approximately 1,500 acres of the land as Federal land instead of accessing the area as private land under the Access Yes Program. If ranch subparcels were eliminated from the exchange, the acquisition of the ranch by the US would not meet the goals of the Upper Salmon River SRMA as well as under Alternative L2.

4.12.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

For properties for which most of the fair market value is due to development potential (river frontage, scenic mountain views, beach frontage, etc.), conservation easements are worth as much as 85 percent of the fair market value of the property. However, a conservation easement on an isolated tract of 1,500 acres of rugged terrain adjacent to the mine with little potential for development (i.e., the easement area of Alternative L5) would be worth approximately 25 to 50 percent of the fair market value of the tract without such easement. Therefore, the fair market value of the selected land would be reduced by approximately 10 percent compared to under Alternative L2. The US would thus acquire approximately 10 percent less by fair market value of the offered lands.

Land Jurisdiction

There would be approximately 10 percent less (by fair market value) of the offered lands acquired by the US as compared to Alternative L2 (long-term, moderate effect).

Land Use

The effects on land use would be similar to under Alternative L2, except approximately 1,500 acres of the selected land would be protected by a conservation easement. Such would allow approximately 10 percent more of the offered lands to be acquired than under Alternative L2 (long-term, moderate effect). Therefore, more of the land uses associated with the BLM ranch management strategies would be implemented (long-term, minor effect). In addition, the BLM would have to administer the easement (see Section 4.13.2.5. for the economic effects).

Special Management Areas

The effects on SMAs would be similar to those under Alternative L2, except there would be slightly more land than under Alternative L4 to help to meet the goals of the Upper Salmon River SRMA.

Recreation

The effects on recreation would be similar to under Alternative L2, except there would be a guarantee of no future disturbance of the selected land via a conservation easement. There would be slightly more land than under Alternative L4 for implementation of the BLM ranch management strategies.

4.13. Socioeconomic Factors

4.13.1. MMPO Alternatives

The baseline economic influence of the mine in Custer County are 1) the TCMC employees living in Custer County, 2) TCMC purchases of goods and services from vendors in the county, and 3) spending by TCMC employees and by employees who work for county vendors. These values were estimated using RIMS II and divided into *direct*, *indirect,* and *induced* economic effects. *Direct* effects are the changes in sales, employment and labor earnings that occur during the first round of spending in the affected industry (i.e., the mine). *Indirect* effects are the changes in sales, employment, and labor earnings in a region in backward-linked industries that supply goods and services to the affected industry. *Induced* effects are changes in sales, employment, and labor earnings in the region resulting from household spending of the income earned in the affected industry and in the supporting industries. Note that essentially all of these direct, indirect, and induced economic effects are *indirect NEPA effects* occurring as a result of activities on private land. Note also that the effects are described for the steady production typical of mine plans, but the effects would probably be somewhat cyclical due to the cyclical price of molybdenum in the world market, e.g., TCMC revised its mining schedule in October 2012 to temporarily delay Phase 8 overburden removal and reduce its workforce from 379 to 274 (TCMC 2012a).

4.13.1.1. Alternative M1 – No Action

TCMC would cease mining in approximately 2016. The annual economic effects of the mine that would not occur after 2016 would be a combined direct, indirect, induced, and secondary employment in Custer County and Idaho, respectively, of 935 jobs and $49.0 million in earnings, and 1,665 jobs and $88.2 million in earnings.

After mining, the annual economic effects during core reclamation would be a combined direct, indirect and induced, and secondary employment in Custer County and Idaho, respectively, of 515 jobs and $27.0 million in earnings, and 830 jobs and $44.1 million in earnings. The annual economic effects during late-stage reclamation would be 45 jobs and $2.5 million in earnings in Custer County and 75 jobs and $4.0 million in earnings in Idaho. The annual effects during long-term reclamation would be 10 jobs and $0.6 million in earnings in Custer County and 20 jobs and $1.0 million in earnings Idaho. There would be no change in BLM grazing revenue, grazing administration costs, or other BLM administrative costs.

Idaho receives approximately $2.5 million each year in personal income tax related to the $88.2 million in earnings from the TCMC mine in Idaho. More specifically, Custer County received $807,921 in property taxes in 2010 from TCMC, as well as substantial amounts of property taxes paid by TCMC employees. Most of these employees would not likely stay in the area after their employment ended at the mine; therefore, most (> 75 %) of these employees would move from the county after core reclamation is completed (Gardner 2012b). The housing market, particularly in Challis, would experience an increase in properties for sale and a decrease in fair market value. The relatively few employment options in the county would decrease substantially at the end mining (~ 180 less jobs) and core reclamation (~ 380 less jobs).

In addition, there would be proportional decreases in population and funding for public schools, and increases in utility costs and property taxes for the remaining county residents. The decrease in population would be concentrated in the Challis locality and would substantially reduce the number of school age children. Schools would accordingly receive less funding from Idaho, with probable increases in student to teacher ratios.

The reduced electricity consumption from the mine closure would have little effect on electricity bills because of the pass-through arrangement among TCMC, SREC, and the Bonneville Power Administration (Diaz 2010). However, the costs of the electricity distribution infrastructure would be divided among fewer SREC members, e.g., an increase in the basic service charge ($30 for most people in 2012) of 25 percent.

There would also be the loss of substantial community support by TCMC and its employees. For example, TCMC has five employees that are fire fighters with the Challis Volunteer Fire Department and six employees that are emergency medical technicians with the Challis Volunteer Ambulance Service. TCMC employees are also involved in partnerships with 18 organizations ranging from the Hospital Board to the 4-H program, and TCMC typically provides more than $100,000 each year to a group of approximately 75 organizations such as the Challis High School, Challis Public Library, Lemhi-Custer Cancer Relief Fund, and Butte County Extension Office (Natoli 2014).

TCMC pays approximately half of all property taxes in the county. In addition, property taxes on residential property, much of which is owned by TCMC employees, were 42 percent of all property taxes paid in 2009 to the county. Mining activities, dominated by TCMC, accounted for 37.5 percent of the tax revenue in the county. The loss of such a large taxpayer would result in a higher tax levy assessment on all real and personal property in the county, particularly for residential property owners in northern Custer County. If the entire tax burden could not be shifted, property tax revenue would decrease with less money to local units of government, school districts, police, fire, ambulance, health, libraries, etc. These entities would have to reduce staff and/or services. All of the ROWs required for the mine are authorized by the current MPO. However, TCMC chooses to also maintain some of these ROWs under the FLPMA, and annually pays the BLM approximately $3,600 in fees for these ROWs.

The mine would produce approximately 80 million pounds of molybdenum during 2012 to 2016. The mine currently (2011) produces approximately 5 percent of the world molybdenum production and approximately 15 to 20 percent of US molybdenum production. Should such molybdenum production permanently cease (e.g., final reclamation under Alternative M1), there would be an immediate increase in the worldwide price of approximately 20 percent, gradually declining over several years with demand destruction and as other producers slowly replaced the supply (Gardner 2012a). The closure of the mine under Alternative M1 would also cause a decrease of 15 to 20 percent in US molybdenum exports, affecting the annual US current account balance (i.e., trade deficit) by a few $100 million.

4.13.1.2. Alternative M2 – MMPO as Submitted by TCMC

The socioeconomic effects would be the same as for Alternative M1, except the BLM would lose the potential to collect minimal revenue (e.g., $2.70 at the 2012 rate) in grazing fees due to the decrease of 2 AUMs for the Thompson Creek Allotment (if the allotment were grazed in the future); grazing administration costs would be the same as for Alternative M1. The mine would also produce an additional 126 million pounds of molybdenum under Alternative M2 compared to Alternative M1, and would not affect US molybdenum exports or affect the US trade deficit until 2026. The socioeconomic effects of the mine would continue (or in some cases be delayed) under Alternative M2 for an additional 9 years compared to Alternative M1 (long-term, major effects). TCMC would probably sell a few truckloads per year (~ 4,000 board feet/truckload) of the timber harvested from the mine (Section 4.4.1.2.) to small, local mills but most of the timber would probably be donated for use as community firewood (short-term, minor effect). In addition, TCMC would save $1,000,000s of dollars by reclaiming the surface of the Buckskin WRSF with less soil cover than for Alternative M1 (Section 2.1.1.8.) (temporary, major effect to TCMC; temporary minor to moderate effect to the vendors which would not receive such business).

4.13.1.3. Alternative M3 – No Name Waste Rock Storage Facility

The socioeconomic effects would be the same as for Alternative M2, except TCMC would incur substantial additional costs (e.g., greater than $10 million) to develop, use and reclaim a new WRSF in a previously undisturbed drainage with a longer haul distance than that of the existing Buckskin and Pat Hughes WRSFs. The development would require new roads, pipelines, a sedimentation pond, an underdrain, diversion ditches, etc. This would be a short-term, major effect to TCMC, and a long-term, moderate effect to Custer County (due to additional vendor income from equipment, materials and services purchased locally by TCMC). Conversely, there would be an increase in incomes and revenues in the analysis area due to an increased need for goods and services to construct the additional waste rock facility that would be greater than that under Alternative M2 (short-term, moderate effect).

4.13.2. Land Disposal Alternatives

4.13.2.1. Alternative L1 – No Action

Custer County would continue to receive approximately $2,000 each year in property taxes for the Broken Wing Ranch. However, a small subdivision of the ranch with residential development along the Salmon River corridor could reasonably be developed in the foreseeable future. Such a subdivision would increase the overall assessed property value of the county, e.g., six river-front homes each on 5 acres with an assessed value of ~ $300,000 would each generate ~ $1,000 in annual property taxes (Custer County 2014). Bannock County would continue to receive $100 each year in property taxes for the Garden Creek property (Hymas 2010). If the Garden Creek property were subdivided in the future and developed into residential property, Bannock County would receive increased property tax revenue from the property.

There would be no change in the property values of lands adjacent to the selected and offered lands due to changes in jurisdiction of the selected and offered lands, e.g., private lands near scenic Federal lands typically have higher fair market value than comparable private lands

located elsewhere (the proximate principle). There also would be no change in BLM grazing revenue, grazing administration costs, or other BLM administrative costs. Also, none of the effects of the BLM gaining title to the offered lands would occur.

4.13.2.2. Alternative L2 – Land Exchange Proposal

Acquisition of the Broken Wing Ranch by the US would result in Custer County not receiving $2,000 to approximately $8,000 in annual property taxes for the property. Transfer of the selected land from the US to TCMC would result in the county receiving approximately $240 to $25,000[10] in annual property taxes for the land (negligible effects). The change in jurisdiction (Federal to private) of the selected land could cause a slight reduction (< 3 %) in the value of private land adjacent or near to the selected land (e.g., the Redbird property). However, there would be no new mining operations (under any of the MMPO alternatives) near any private land; the mine has been operating for more than 30 years; and there would be little change to the public access of the selected land (Section 4.12.2) (long-term, minor effect). If Custer County were to sell the two donated parcels on the ranch, the county would receive a few $100,000s (and ~ $1,800 in annual property taxes). The BLM (non-standard) administrative costs for the ranch would be approximately $8,000 the first year and $1,500 for each subsequent year, plus approximately $5,000 to $10,000 to install interpretive kiosks/signs (negligible effects). If the ranch were leased, the BLM would probably receive a few $1,000s per year for the fair market value of the lease (negligible effect) (Gardner 2013a).

The change in jurisdiction (private to Federal) of the offered lands may cause a slight increase in the value of private lands near the Broken Wing Ranch, e.g., the ranch would not be subdivided for residential development along the Salmon River (long-term, minor effect to property values). There would be no such effect related to the Garden Creek property because there is no private land near the property. The PILT payments to Custer County would not change if the county was to gain additional Federal acres due to the population cap, as the county would have to lose more than 800,000 qualified Federal acres before PILT payments would be reduced. The transfer of the Garden Creek property to the US would result in the annual decrease of $100 (bare land) or as much as $20,000 (developed land) of future property taxes for Bannock County (negligible effect).

The counties would not receive any construction revenue from the potential development of the offered lands (negligible effect). However, the ranch would continue to raise approximately 300 AUMs of cattle each year providing farm income (long-term, minor effect), and annual grazing fees to the BLM of $405 (300 AUMs x $1.35/AUM, negligible effect). In addition, the ranch could provide new recreational and educational opportunities, including a revenue-generating facility for the Idaho Parks and Recreation Department (long-term, minor effect).

The BLM (Washington Office via non-appropriated funds) would no longer receive approximately $60,000 each year from TCMC to maintain mining claims on the selected land (negligible effect) (Gardner 2012a). The BLM would also probably stop receiving annual fees of approximately $3,600 from TCMC for ROWs on the selected land (negligible effect). However,

[10] The property taxes would be calculated as a base rate (depending on the appraisal category and appraisal factor) multiplied by the acres subject to the base rate multiplied by the levy rate. The appraisal categories and appraisal factors would depend on how TCMC uses the portion of the land not covered by an MPO.

the BLM would save of the order of $10,000 each year in administrative costs related to the MMPO (long-term, minor effect). If the BLM would no longer administer the MPO for the mine (Section 1.4.), TCMC would save of the order of $10,000 each year in administrative costs by reducing the redundancy of three land management agencies to two land management agencies (long-term, minor effect).

Under Alternative L2 the BLM would have the same grazing administration costs for the S. Creek and Thompson Creek allotments, and would collect the same grazing revenue for the S. Creek Allotment as under Alternative L1. However, the BLM would not collect annual grazing fees for 41 AUMS in the Thompson Creek Allotment should the allotment be grazed in the future (41 AUMs x $1.35/AUM = $55.35, negligible effect). Given the few remaining AUMs in the allotment and the resource concerns along the Thompson Creek riparian area where most grazing in the allotment has typically occurred, the BLM would probably consider amending the Challis RMP to make the Thompson Creek Allotment unavailable for livestock grazing. In this case, the BLM would decrease its grazing administration costs (due primarily to NEPA analysis and associated litigation) of the order of $10,000 each year (long-term, minor effect).

Under Alternative L2-B the cultural character of the ranch would change completely, i.e., operating agricultural/cattle ranch since the early 1900s to vacant (except for the fences and the one or two parcels donated to Custer County or the parcel sold by TCMC) sagebrush grasslands (long-term, moderate effect). There would be a reduction of 1 of the 261 farms (0.4 %) in Custer County (Table 3.13-12.), and the elimination of perhaps the most scenic ranch in the county (long-term, minor effect). The BLM Challis Field Office would need to reimburse the Bonneville Power Administration $150,000 for the conservation improvements tied to the conservation easement for the ranch (WSLM 2012), (one-time, major effect to the field office budget). The BLM Challis Field Office would also need to maintain the fences at average costs per year of approximately $500 (~ 2 days of maintenance) and $6,000 (fence replacement; recent fence construction on the ranch of $57,000/11,790 feet ≈ $5/foot; fence on ranch ≈ 49,000 feet; 40 year fence life) (long-term, negligible or minor effect). In addition, the BLM would not receive grazing fees (2,390 AUMs/year x $1.35 = $3,200/year) or a lease fee (few $1,000s) for the ranch (long-term, minor effect).

Under Alternative L2-B the BLM cost to convert the ranch to native vegetation would be approximately $215,000 the first year, and $110,000 for the second and third years, with $150,000 earned from salvage of the irrigation equipment (Gardner and Redick 2013) (short-term, major effects to the field office budget), with a (non-standard) weed eradication cost of approximately $2,000 per year for 5 to 10 years (negligible effect). The BLM would not have the (non-standard) costs to administer the ranch, and would not receive a few $1,000s in grazing or lease fees (negligible effects). The ranch operator would lose $60,000 in annual revenue from hay production (150 tons/cutting x 2 cuttings x $200/ton) as well as approximately 2,400 AUMs of forage. To compensate for the loss of forage, the operator would need to each year 1) pay private grazing fees of $35,000 ($14.50/AUM) (if so many private AUMs were available in the region), 2) purchase hay for $187,000 ($77/AUM), or 3) reduce the cattle herd with a loss in revenue of $249,000 ($102.50/AUM) (long-term, major effects) (Section 3.13.2.1).

4.13.2.3. Alternative L3 – Land Sale

The effects would be the same as for Alternative L1, except the US Treasury would have a one-time gain of several million dollars (negligible effect), Custer County would receive approximately $240 to $25,000 in annual property taxes for the selected land (negligible effect), and the effects of the US acquiring the offered lands as outlined under Alternative L2 would not occur. In addition, if the land was sold to a party other than TCMC, the company would probably incur $10,000s to $100,000s per year in costs from operating on private property not owned by TCMC (long-term, major effect).

4.13.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The effects would be similar to under Alternative L2, except Custer County would receive approximately $170 to $17,000 in annual property taxes for the smaller amount (reduced by ~ 1,500 acres) of selected land compared to approximately $240 to $25,000 under Alternative L2 (or no additional property taxes under Alternative L1). In addition, the county would receive approximately $600 (30 % of $2,000) instead of $0 under Alternative L2 ($2,000 under Alternative L1) in annual property taxes for a small area of the Broken Wing Ranch that would not be acquired by the US; the US would probably acquire all of the ranch with high development (tax revenue) potential. It is also possible that less or none of the Garden Creek property would be acquired by the US. Regardless, all of the effects would be negligible.

4.13.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects would be similar to those of Alternative L4, except Custer County would receive as much as $170 more in annual property taxes due to the approximately 1,500 acres of selected land under the conservation easement. In addition, the county would receive approximately $200 (10 % of $2,000) instead of approximately $600 under Alternative L4 (because there would be an even smaller area of the ranch than under Alternative L4 that would not be acquired by the US). It is also possible that less of the Garden Creek property would be acquired by the US (negligible effects). In addition, the BLM would have to administer the easement for the 1,500 acres (~ 6 hours/year staff time; $300/year) with the costs paid for by a trust fund established by TCMC (average annual investment return = 4 %, $7,500 principal), and a similar conservation easement (land disposal provisions, Section 2.2.7.) for Thompson Creek and S. Creek (minor effect to TCMC).

4.13.3. Non-market Environmental Monetary Value

In the case of the MMPO and land disposal alternatives there would be non-market monetary value for all resources – even things like land, easements, and water rights have non-market monetary value to those other than the seller and purchaser. Therefore, it is not feasible to identify the specific amounts that a myriad of people would theoretically pay for a myriad of abstract environmental values. However, given the relatively small areas, number of affected people, and magnitude of effects involved with these aspects of the project, the non-market value for each of the MMPO and land disposal alternatives is of the order of perhaps $1,000 or $10,000 per year primarily related to the value of private property adjacent to Federal lands and changes in public access. For example, people in Custer County have tremendous emotional value regarding access to land for recreation, but few people in the county would pay for the public access that would be gained or to avoid the loss of such under any of the alternatives.

4.13.4. Financial Guarantee

Under all of the MMPO alternatives (including Alternative M1), TCMC would fully reclaim the mine according to the approved reclamation plan. Regardless, the BLM, Forest Service, IDL, and IDWR would also continue to hold financial guarantees in the amount necessary to complete such reclamation using a third-party contractor, and would adjust the guarantees to conform to the reclamation plan that would be approved under the chosen MMPO action alternative. In particular, the BLM would require TCMC to establish a trust fund or other funding mechanism pursuant to 43 CFR 3809.552(c) to ensure the continuation of long-term water treatment to achieve State WQSs, NPDES effluent limitations, and for other long-term, post-mining maintenance requirements required by the reclamation plan (Section 1.9.21).

If the land exchange were completed, the IDL would obtain a financial guarantee comparable to that required by the BLM for the "earthworks" portion of the reclamation plan on BLM land, and the BLM would subsequently release the financial guarantee for such reclamation. However, the IDL may not have the authority to hold a financial guarantee for long-term water quality or other long-term, post-mining maintenance according to the reclamation plan. Consequently, any ROD approving a land disposal alternative would be conditional on TCMC establishing an irrevocable trust fund or other funding mechanism with the IDL for such long-term water treatment or other long-term requirements. The trust fund or funding mechanism would be identical or similar to that required by 43 CFR 3809.552(c) (Section 1.9.21). In such case, there would be essentially the same financial guarantee available to the IDL for the land disposal action alternatives as there would be available to the BLM for Alternative L1. The trust fund or funding mechanism would be identical or similar to that required by 43 CFR 3809.552(c) (Section 1.9.21). In such case, there would be essentially the same financial guarantee available to the IDL for the land disposal action alternatives as there would be available to the BLM for Alternative L1. For the land disposal action alternatives, if the BLM were no longer involved in administering the mine, only two (Forest Service and IDL) instead of three land management agencies for Alternative L1 would conduct inspections of the mine related to the MPO; a decrease of approximately four inspections per year.

4.14. Tribal Treaty Rights and Interests

4.14.1. MMPO Alternatives

The goal of the BLM Challis Field Office, the Forest Service, and the USACE regarding Tribal treaty rights and interests is to identify and consider Native American issues and concerns to accommodate treaty and other legal rights as well as other interests of appropriate Native American groups in the multiple-use management of Federal lands. Most of the effects to resources described in the other sections would affect Tribal treaty rights where those resources would occur on unoccupied Federal lands. Therefore, this section provides only a summary of those effects from the perspective of Tribal treaty rights, with a focus on unoccupied Federal lands.

4.14.1.1. Alternative M1 – No Action

The Federal lands in the BLM Challis Field Office area (793,081 acres) and SCNF (4,235,940 acres) are mostly undeveloped land, i.e., 98 to 99 percent of these lands would be unoccupied Federal lands available to exercise Tribal treaty rights (Gardner 2011b). There would not be any change to the amount of unoccupied Federal lands under Alternative M1. Both the Shoshone-Bannock and the Nez Perce tribes expressed concern over the stability of mine facilities such as the TSF and the pit lake during major seismic or flood events. Extensive and detailed site-specific geotechnical analyses demonstrate stability under both static and dynamic (i.e., during seismic shaking) conditions for the existing pit walls and the existing WRSFs and the TSF. The facilities would be stable during the maximum credible earthquake during both mining (temporary) and after reclamation (long-term). There would not be any effects to vegetation, forest resources, or weeds that would affect Tribal treaty rights, i.e., the mine operations that affect these resources would all be on occupied Federal lands.

The changes to water quantity and quality would effectively occur during two separate periods: mining and reclamation. The changes during mining that might affect Tribal treaty rights would include a very small reduction (1 %) in the flow of Thompson Creek due to installation of cutoff walls and sedimentation pond linings in the Buckskin Creek and Pat Hughes Creek drainages. After mining the changes to water quantity and quality that could affect Tribal treaty rights would include decreased water quality in S. Creek due to the acidification of the tailings embankment sands (late reclamation), including increased concentrations of sulfate, aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, nickel, uranium, and zinc under both best and upper estimates for low flow and the 7Q10 flow. With the exception of the concentration of cadmium for the 7Q10 flow/upper estimate, the concentrations of these constituents would meet the WQSs. Also, there would be the potential for decreased water quality due to problems in the long-term water management system. The water quality effects to S. Creek would be a long-term, moderate, adverse effect to Tribal use of S. Creek.

During periods of extremely low flow in S. Creek (on average once every 10 years) and for the predicted upper estimate (i.e., worst-case scenario), the concentration of cadmium would slightly exceed the WQS: 1.11 µg/L compared to the WQS $CCC_{cadmium}$ of 0.74 µg/L. The effects to fish in S. Creek for such exceedance cannot be accurately quantified, but would include at worst reduced survival of larval fish beyond baseline levels of larval mortality, or avoidance behavior that may limit feeding, migration, or predator avoidance. Accordingly, there could be a short-term decrease in juvenile recruitment for that year and a possible decline in fish population size to reduced adult fish health. However, cadmium does not readily bioaccumulate in fish (EPA 2011a). Any declines in fish population size for Chinook salmon, steelhead/rainbow trout, cutthroat trout, and sculpin would probably not reduce population viability in S. Creek as reproduction and recruitment in subsequent normal or higher-flow years would be unaffected (long-term, negligible to minor adverse effect on Tribal treaty rights associated with subsistence fishing).

4.14.1.2. Alternative M2 – MMPO as Submitted by TCMC

The expansion of the mine would increase the amount of occupied Federal lands in the BLM Challis Field Office area and SCNF, and reclamation would gradually return the mine site to unoccupied Federal lands of a condition where hunting, gathering, and other treaty rights could be exercised. There would be no known Tribal resources in the analysis area that would not be available in the remaining portions of the BLM Challis Field Office area or SCNF.

There would be an additional 386 acres of occupied Federal lands for the mine operations, less than 0.01 percent of the unoccupied Federal lands in the BLM Challis Field Office area and SCNF. The tribes would not be able to exercise treaty rights in this additional area of mine disturbance for the foreseeable future (long-term, minor, adverse effect on Tribal treaty rights). The extensive geotechnical analyses demonstrate that the pit walls, WRSFs, and TSF would be stable under both static and dynamic (i.e., during seismic shaking) conditions, including during the maximum credible earthquake during both mining and reclamation.

Certain plants are important for traditional Tribal uses including chokecherry, elderberry, current, red-twig dogwood (red willow), tulles, onions, turnips, all water plants (such as mint and watercress), huckleberry, gooseberry, raspberry, strawberry, sweet sage, carrots, bitterroot, camas, aspen, juniper, and lodgepole pine. Many of these plants would occur in the analysis area, but would not be available for Tribal use in the expanded mine area for the foreseeable future (long-term, minor, adverse effect on Tribal treaty rights). Despite weed management by TCMC, the additional 497.9 acres of disturbance at the mine would cause an increased threat of weed infestation at and near the mine (long-term, minor, adverse effect to Tribal use of vegetation).

There would be a very small decrease in flow in Thompson Creek (an additional 1 % compared to Alternative M1) due to increase disturbance and the cutoff walls. There would be an additional decrease in the water quality in Thompson Creek due to increased waste rock storage in the Buckskin Creek drainage and the Pat Hughes Creek drainage. The concentrations of copper, lead, and manganese would increase for the best estimate for both the low flow and the 7Q10 flow. The concentrations of aluminum, cadmium, cobalt, copper, iron, lead, manganese, uranium, and zinc would increase for the upper estimate for both low flow and the 7Q10 flow. However, with the exception of the concentration of copper for the 7Q10 flow/upper estimate, the concentrations of these constituents would meet the WQSs (long-term, moderate, adverse effect to Tribal use of Thompson Creek). There might be short-term declines in fish population size for bull trout, Chinook salmon, steelhead/rainbow trout, cutthroat trout, and sculpin, but there would not likely be a reduction in population viability in Thompson Creek as reproduction and recruitment in subsequent higher-flow years would be unaffected (negligible to minor adverse effect on Tribal treaty rights for subsistence fishing).

There would not be any effects to the availability or populations of game species that would affect Tribal hunting rights, except for a slight decrease in the amount of land available for Tribal hunting (long-term, minor, adverse effect to Tribal treaty rights for wildlife). Recreational access, including Tribal hunting access, would not be available on an additional 386 acres of Federal land used for mining (Table 2.1-5.), less than 0.01 percent of the land available to

practice Tribal treaty rights in the analysis area (long-term, minor, adverse effect). There would not be any effects to traditional cultural properties eligible for the NRHP. Site 10CR758 (eligible for the NRHP) would be partially inundated by the expansion of the TSF (long-term, adverse effect) (Section 4.21.6).

4.14.1.3. Alternative M3 – No Name Waste Rock Storage Facility

The effects to Tribal treaty rights would generally be the same as under Alternative M2. The exception would be 659 acres less unoccupied Federal land available to exercise Tribal treaty rights due to the construction of the No Name WRSF (long-term, minor, adverse effect).

4.14.2. Land Disposal Alternatives

4.14.2.1. Alternative L1 – No Action

There would be no affect to Tribal treaty rights, and no change in the amounts of unoccupied Federal lands in the BLM Challis Field Office area, SCNF, or Pocatello Field Office Area. There would be no change in the area available for Shoshone-Bannock Tribal preference use within the ceded boundary of Shoshone-Bannock Tribal trust resources (Fort Hall Indian Reservation). The 10 prehistoric cultural resource sites on the selected land would remain under Federal management. The four prehistoric cultural resource sites on the ranch would remain on privately owned land.

4.14.2.2. Alternative L2 – Land Exchange Proposal

Approximately 5,100 acres of BLM land (~ 4,450 acres unoccupied) would become private land owned by TCMC, and the US would acquire 813 acres of private land (Broken Wing Ranch) in the BLM Challis Field Office area. The ranch would become available for practicing Tribal treaty rights except for approximately 30 percent (~ 240 acres) of the ranch occupied with irrigated fields, roads, or structures. The result would be a net decrease of approximately 3,890 acres of unoccupied Federal land in the BLM Challis Field Office, approximately 0.5 percent of the unoccupied Federal land in the BLM Challis Field Office area (long-term, minor, adverse effect to Tribal treaty rights).

The acquisition of the Garden Creek property would increase the amount of unoccupied Federal land in the BLM Pocatello Field Office area by approximately 0.01 percent, and increase the amount of unoccupied Federal land within the ceded boundary of the Fort Hall Indian Reservation by 82 acres (0.03 %). This land would be available for the exercise of Tribal treaty rights as well as Shoshone-Bannock Tribal timber and grazing rights (e.g., 72 AUMs, Section 3.5.3.) (long-term, minor, beneficial effect to Tribal treaty rights).

The BLM would acquire the water rights for the Broken Wing Ranch, and would work to increase the flow in Lyon Creek to benefit fisheries resources and riparian vegetation, and fish passage to Lyon Creek would be improved by the removal of a pond/dam near the mouth (long-term, negligible to minor, beneficial effects to Tribal treaty rights for subsistence fishing). There would be economic value to the Shoshone-Bannock Tribes if preference Tribal grazing or timber harvest occurred on the Garden Creek property (e.g., 72 AUMS x $14.50/AUM = $1,044.00) (long-term, minor effect). The Shoshone-Bannock and Nez Perce tribes would not

have the opportunity of obtaining economic value from hunting, fishing, and gathering on a net decrease in unoccupied Federal lands (long-term, minor, adverse effects).

There would no longer be Federal oversight of the cultural sites on the selected land. However, as the sites are not eligible for the NRHP, the BLM is not required to preserve them (long-term, minor, adverse effect). The cultural sites on the ranch are in areas that would continue to be managed for agriculture, and there would be no adverse effects to these sites. One of the sites is eligible for the NRHP and another is considered unevaluated for the NRHP. These two sites would have Federal oversight and would be managed under the Challis RMP (long-term, moderate, beneficial effect). There are no known cultural sites at the Garden Creek property. Under Alternative L2-B compared to Alternative L2 there would be easier Tribal access to the ranch and the Lyon Creek drainage (long-term, minor, beneficial effects).

4.14.2.3. Alternative L3 – Land Sale

There would be a decrease of approximately 4,450 acres of unoccupied Federal land in the BLM Challis Field Office area, approximately 0.5 percent of the unoccupied Federal land in the BLM Challis Field Office area (long-term, minor, adverse effect).

4.14.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

There would be a decrease of approximately 2,390 acres (~ 0.3 %) of the unoccupied Federal land in the BLM Challis Field Office area from disposal of the selected land, and an increase of perhaps 400 acres (0.05 %) of unoccupied Federal land in the BLM Challis Field Office area due to acquiring approximately 30 percent less by fair market value of the ranch (long-term, minor, adverse effect to Tribal treaty rights). The Garden Creek property also may not be acquired (long-term, minor, adverse effect to Tribal treaty rights compared to Alternative L2).

If the water rights associated with the ranch subparcels along Lyon Creek were eliminated from the land exchange, there would be no effect on water quantity in Lyon Creek or the Salmon River. If the portion of the ranch with the dam and pond proposed for removal (BWR-2) were not acquired by the US, the benefits to fish movement between Lyon Creek and the Salmon River would not occur (long-term, minor, adverse effects to Tribal treaty rights compared to Alternative L2). The effects to the 10 prehistoric cultural resource sites on the selected land would be the same as for Alternative L2 because all of the sites would be in the reduced area of selected land (i.e., the remaining selected land that would leave Federal jurisdiction). Any prehistoric cultural resources sites on portions of the ranch not acquired by the US would remain privately managed.

4.14.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects to Tribal treaty rights related to the selected land would be essentially the same as for Alternative L2 because there would be effects in the foreseeable future for the portion of the selected land that would be subject to the conservation easement, even if the easement was not obtained by the BLM. The effects to Tribal treaty rights related to the offered lands would be essentially the same as for Alternative L4. Slightly more of the ranch and/or the Garden Creek property would be acquired by the US, but not enough to change the magnitude of the effects compared to Alternative L4.

4.15. Cultural Resources

4.15.1. MMPO Alternatives

4.15.1.1. Alternative M1 – No Action

Under the No Action Alternative, there would be no effects to NRHP-eligible cultural resources. The nearby NRHP-eligible cultural sites would not be affected by mine-related traffic or activities.

4.15.1.2. Alternative M2 – MMPO as Submitted by TCMC

The Cinnabar/Bruno Creek Mine/ lithic scatter (10CR758) has been determined to be eligible for the NRHP and a portion of the site would be located within the MMPO area. This site would be adversely affected under Alternative M2 in the long term. Mitigation and further consultation related to this site is described in Section 4.21.6. The other eleven cultural resource sites within the MMPO area are not eligible for the NRHP; two NRHP-eligible sites are located outside of MMPO boundaries (SHPO 2011).

4.15.1.3. Alternative M3 – No Name Waste Rock Storage Facility

The effects to cultural resources would be the same as under Alternative M2 as there are no known cultural resources in the area of the proposed No Name WRSF; there would be no effects to NRHP-eligible cultural resources (no effect).

4.15.2. Land Disposal Alternatives

4.15.2.1. Alternative L1 – No Action

There would be no change in the jurisdiction of cultural resources (no effect). The NRHP-eligible cultural site near Forest Service Road #040 would have the potential for inadvertent alteration via recreational use or damage via unauthorized collection and vandalism. Cultural resources at the Broken Wing Ranch and Garden Creek property would not have consideration/protection under Federal laws and regulations.

4.15.2.2. Alternative L2 – Land Exchange Proposal

Two potentially NRHP-eligible and five NRHP-eligible cultural sites would come under BLM administration and would then be afforded consideration/protection under Federal laws (long-term, moderate beneficial effect). No cultural resource sites are known at the Garden Creek property (no effect). Any future actions/activities on the ranch or the Garden Creek property would require compliance with the NHPA of 1966 (as amended) as well as any other applicable Federal law or regulation.

4.15.2.3. Alternative L3 – Land Sale

The cultural resource sites on the selected land would leave BLM administration, but these sites have all been determined by SHPO (2011) as not eligible for the NRHP (no effect). The cultural resource sites (including NRHP-eligible sites) on the Broken Wing Ranch would remain under private ownership (no effect). The Garden Creek property would also remain under private ownership (no effect).

4.15.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

The effect to cultural resources on the reduced area of selected land would be the same as under Alternative L3 (regardless of how many fewer cultural sites would leave Federal ownership). There would probably be fewer NRHP-eligible cultural sites that would come under BLM administration. Any future actions/activities on the ranch or the Garden Creek property under BLM administration would require compliance with the NHPA of 1966 (as amended) as well as any other applicable Federal law or regulation.

4.15.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

The effects to cultural resources would be the same as for Alternative L4.

4.16. Transportation, Access, and Public Safety

4.16.1. MMPO Alternatives

4.16.1.1. Alternative M1 – No Action

There would be no material changes relating to transportation, access, and public safety for the mine through 2016 (during molybdenum production/full mining). For example, there would be the same (TCMC and non-TCMC) traffic volumes at the mine and in the mine region with TCMC traffic comprising approximately 40 percent of the traffic on SH 75 between the TCM Access Bridge and the junction of SH 75 with US 93. The rate of (TCMC and non-TCMC) highway traffic accidents would be unaffected. The rate of traffic accidents and occupational injuries or illnesses at the mine would be expected to be the same or slightly less due to continued efforts to increase safety. No occupational fatalities and no highway spills of molybdenum are reasonably foreseeable.

During the first 3 years of core reclamation under Alternative M1 the TCMC workforce would decrease to approximately 220 employees, but the mine would receive a similar amount of miscellaneous traffic. For the next 5 years of late-stage reclamation (i.e., monitoring and maintenance) the workforce would decrease to approximately 20 employees with an average of approximately five miscellaneous roundtrips per day. The workforce would then decrease to approximately 5 employees for long-term reclamation with an average of potentially one or two miscellaneous roundtrips per week (Doughty 2012). Therefore, TCMC traffic would be reduced throughout reclamation proportional to the number of employees, i.e., the TCMC traffic would be 20 percent of the traffic on SH 75 during core reclamation, 2 percent of the traffic during late-stage reclamation, and 0.5 percent of the traffic thereafter. There would be proportional decreases in the potential rate of TCMC traffic accidents on SH 75 and no chance of molybdenum spills.

After reclamation the lower portion of Thompson Creek Road would probably be maintained by the Forest Service instead of TCMC, and the lower portion of S. Creek Road would probably be maintained by Custer County instead of TCMC. It is unknown who would be responsible for maintaining the TCM Access Bridge in the long term. There would also be short-term wear from TCMC traffic on the surface of SH 75, and to a much lesser degree on the surface of US Highway 93 (the highways are typically resurfaced on a 7 year cycle).

4.16.1.2. Alternative M2 – MMPO as Submitted by TCMC

The mine would operate in the same basic manner with the same overall traffic patterns (and the regional traffic patterns are not expected to materially change in the foreseeable future). However, the effects related to transportation, access, and public safety during mining would occur through approximately 2025 instead of 2016, and the effects during core reclamation would occur from approximately 2025 to 2040 instead of from approximately 2016 to 2031.

4.16.1.3. Alternative M3 – No Name Waste Rock Storage Facility

There would be construction of a haul road approximately 300 feet in length and 70 feet in width to the upper No Name Creek drainage from the upper mine site, and the substantial improvement of the existing two-track road that begins at the base of the drainage (MP 5.2 on Thompson Creek Road) to a year-round mine access road of approximately 20 feet in width (long-term, minor effects).

The BLM would also grant an exclusive easement to TCMC for use of No Name Road, and TCMC would install a gate at the start of the road. There would be daily TCMC traffic (mostly haul trucks) on the upper road to the No Name WRSF during much of the mining through 2025 and to a lesser extent during reclamation through 2031, with a proportional decrease in traffic to the Pat Hughes and Buckskin WRSFs. There would be daily TCMC traffic on the No Name Road during the initial construction of the No Name WRSF, and weekly TCMC traffic on the road to monitor water management facilities (i.e., pipeline and sedimentation pond) and to collect water samples from the toe area of the facility (negligible effects, except a long-term, minor effect for the gate at the start of No Name Road).

4.16.2. Land Disposal Alternatives

4.16.2.1. Alternative L1 – No Action

Transportation, access and public safety related to the selected land would be the same as present, and the same transportation network and the same (TCMC and non-TCMC) traffic volumes would occur in the mine region with the same public access on North Slate Creek, Thompson Creek, S. Creek and Bruno Creek roads, and branches to these roads. However, the land disposal provisions related to transportation and access (Section 2.2.7.) would not occur.

There would be no public safety issues for the offered lands. The Broken Wing Ranch would have the same transportation network. Short portions of road may be developed adjacent the Salmon River if some of the riverfront property of the ranch was developed into exclusive residential/recreational property. The public and the BLM would not obtain access to the ranch, including vehicle access to the Lyon Creek drainage and to Leuzinger Spring at the end of Leuzinger Spring Road (Figure 2.2-3). Traffic on the ranch would continue to be one or two vehicle roundtrips and a few OHV trips per day, and perhaps less than a dozen people per year would visit the upper Lyon Creek drainage. Boaters would not have legal access to upland areas along 4.4 miles of Salmon River frontage. The public and the BLM would not gain access to the Garden Creek property. There would not be roads constructed on the property unless it was developed residentially. The property would continue to be visited by perhaps one person per year. The Challis East Subdivision Trail would not be developed.

4.16.2.2. Alternative L2 – Land Exchange Proposal

There would be no meaningful effects to public safety for the selected land. There would be no effects to transportation or access related to Thompson Creek Road and S. Creek Road, i.e., public access would be retained via easements to the BLM. No changes are foreseen in the public tours of the mine currently provided by TCMC, but the public would probably not be able to visit the mine on a BLM-sponsored annual tour pursuant to 43 CFR 3809.900.

The BLM would grant the owners of the Twin Apex a non-exclusive (non-public) easement prior to the land exchange for permanent access to their property via the Bruno Creek Road. The public would have essentially the same hiking access to the selected land, via the IDFG Access Yes Program (assuming approval by the IDFG) (negligible effects). However, the BLM and public would acquire access to certain roads and potential trails, and to large areas of associated Federal land via the land disposal provisions (Section 2.2.7.) (long-term, moderate effect).

First, the public would acquire permanent legal access to the South Butte Road, which branches east from S. Creek Road at MP 1.7. The start of the South Butte Road and one other portion of the road are on property owned by TCMC. The company has allowed public access on the road, but it is unknown how long such access would continue without a recorded easement, e.g., the property could be sold and the new owner may close the road. Permanent legal access to South Butte Road would ensure continued, ready access to more than 7,000 acres of BLM land typically accessed by the South Butte Road due to the land jurisdiction patterns in the locality, the extremely rugged topography, and the absence of other roads (long-term, moderate effect).

Second, the BLM would acquire administrative access to use roads on private property controlled by TCMC to reach the Saturday Mountain pasture of the S. Creek Allotment. The area is now essentially inaccessible to the BLM and its permittees (without permission from TCMC to cross its property) due to the land jurisdiction patterns in the locality, the rugged topography, and the existence of only one private road leading into the area. The right to use these roads would provide ready access to approximately 2,500 acres of Federal and State land, excluding the selected land (long-term, minor effect).

Third, the public may acquire 1.5 miles of access through a large tract of land owned by TCMC in the Challis East subdivision. The trail would be used by perhaps one or two people on each weekday, and five or 10 people on weekends, and would connect to the extensive BLM Blue Mountain Trail System to the west, and possibly (with future easements from other property owners) to the Salmon River to the east. Either the BLM or the City of Challis could accept the easement for the trail from TCMC, but would do so only if the trail would be supported by most of the property owners in the subdivision (long-term, minor effect).

There would be an increased probability of vehicle accidents on the ranch (long-term, minor effect). However, the transportation network on the ranch would remain essentially the same, apart from minor road improvements. Any development of a campground or recreational or interpretive facilities would utilize primarily existing roads, apart from perhaps internal campground loop roads (negligible effects). Under Alternative L2-B only the main ranch roads would remain in the long term, and approximately 10 miles of dirt two-tracks (used only for ranch operations) would be eliminated (negligible effect). The southern road on the ranch would

also provide access to Lyon Creek Road all year, and using the southern road would be shorter (0.9 mile) than using the Sink Creek and Lower Sink Creek roads to access the Lyon Creek Road (long-term, minor effects).

The BLM and the public would gain access to the ranch via Poverty Flat Road (the Lyon Creek Bridge would have only BLM administrative access). The public would also be able to access all of the ranch during the non-growing season (mid-October to mid-April), but would not be allowed in the cultivated fields during the growing season. There would be only non-motorized access on Lyon Creek Road to the Lyon Creek drainage starting from near the main ranch house next to Lyon Creek (or starting 1.3 miles further on Lyon Creek road near the western edge of BWR-1 under Alternative L2-B). However, the public would gain ready access to these points and 10,500 acres of BLM land in the Lyon Creek drainage via the main ranch road on the west side of the Salmon River (long-term, moderate effects).

The public would also gain ready access to 4.4 miles of Salmon River frontage, including a new parking area. There would not be public access to the two private parcels (2.5 acres each) with houses donated by TCMC to Custer County, except to use the roads that pass by or through the parcels. There would also be firearm safety zones around the two ranch houses on these parcels. The BLM would also acquire vehicle access to Leuzinger Spring and Lyon Creek via the Broken Wing Ranch (Figure 2.2-3). The access to Lyon Creek would allow the BLM to obtain valuable fish monitoring data in the long term (TCMC currently allows the BLM full access to the ranch, but previous owners have not allowed the BLM to collect data on the ranch or to pass through the ranch to access BLM land north of the ranch including all of Lyon Creek). These effects to access and public safety overall would be long-term and moderate.

Traffic on the main ranch road would increase on average by perhaps a few vehicle roundtrips per week during summer and fall, with much of the traffic concentrated on weekends and headed toward the Lyon Creek drainage. Development of a campground would cause an additional increase on average of perhaps three vehicle roundtrips per day during the summer, fall, and the March steelhead season, again with much of the traffic concentrated on weekends. The vehicles would be mostly cars and pickup trucks, but there would be some ATVs and motorcycles. None of the increased traffic would occur near residences currently adjacent to the ranch, but the increased traffic would be noticeable at a distance to nearby residents (long-term, moderate effects).

There would be no effects to transportation or public safety at the Garden Creek property, which would remain undeveloped. However, as Federal land, the property would be visited by possibly a few more people each year (long-term, minor effect).

4.16.2.3. Alternative L3 – Land Sale

The effects related to the selected land would be the same as for Alternative L2, unless the land was sold to a party other than TCMC. In such case the access provisions of the land disposal action alternatives (Section 2.2.7.) would not occur (long-term, major effects). There also would not be an opportunity for the BLM, if necessary, to establish a safety zone (public closure order) around the mine (negligible effect).

4.16.2.4. Alternative L4 – Reduced Area Land Exchange, Fee Simple

There would be no effects related to the reduced amount of selected land. That is, there would be no roads in the reduced area of selected land and the BLM and public would have the same (limited) access to the mine locality as under Alternative L1. Acquiring less of the offered lands would reduce the transportation routes and access that would be available to the BLM and the public compared to under Alternative L2, with a somewhat proportional reduction in traffic on roads on the ranch. In addition, depending on which lands were not acquired, there may not be access along the Salmon River and Lyon Creek, there may not be access to recreational facilities and interpretive sites, and there may be subdivision development along the Salmon River (4.4 miles) and Lyon Creek (0.9 miles). For all possible configurations of less offered lands, the effects would probably be long-term and moderate.

4.16.2.5. Alternative L5 – Reduced Area Land Exchange, Easement

Under Alternative L5, compared to Alternative L1, there would be no differences in the effects to transportation, access, or public safety for the selected land, even with a conservation easement on approximately 1,500 acres of the land. That is, there are no roads in the easement area, and the public would have non-motorized access to the easement area under Alternative L5, as well as under all of the other land disposal alternatives, e.g., via the IDFG Access Yes Program in the case of Alternative L2.

Acquiring less of the offered lands would somewhat proportionally reduce the effects to transportation and access compared to under Alternative L2. This effect would be long-term and minor to moderate, unless the reduction in land would not allow the BLM and public to access the Lyon Creek drainage, the Salmon River frontage along the ranch, or would allow subdivision and development along the Salmon River and Lyon Creek (long-term, moderate to major effect).

4.17. Hazardous Materials and Solid Waste

There would be no change to hazardous materials, solid waste, or petroleum product transport, use, storage or disposal at the mine under any of the MMPO alternatives, except that the use of such materials would continue for a longer duration under Alternative M2 and Alternative M3 compared to under Alternative M1. All storage areas for these materials have secondary spill control features (e.g., containment sumps and/or double wall tanks) to prevent release of the spilled material to the environment. There would always be a small probability for these materials to spill until reclamation was complete. The most probable spills would be fuel, hydraulic oil, and coolant from mobile equipment. However, the mine would address all spills under its Spill Prevention, Control, and Countermeasures Plan (ARCADIS 2010) (long-term, minor effects).

There would be no hazardous materials or solid waste at the selected land under any of the land disposal alternatives. The only hazardous materials or solid waste at the Broken Wing Ranch would be common household/farm items such as fluorescent light bulbs and batteries and fluids (e.g., oil and antifreeze) in vehicles and equipment. Under the land disposal action alternatives there might be a slightly lower or a slightly higher probability of environmental damage from hazardous materials or solid waste at the ranch due to Federal ownership. For example, lease/contact compliance inspections would help ensure compliance with regulations regarding

hazardous materials and solid waste, but there is generally a higher probability of illegal dumping on Federal land than private land (long-term, minor effect). There would be no hazardous materials or solid waste at the Garden Creek property under any of the land disposal alternatives, unless such materials or waste were illegally dumped at the property. The probability of illegal dumping at the property is extremely low and would be the same for all of the land disposal alternatives.

4.18. Unavoidable Potentially Significant Adverse Effects

Unavoidable in this section refers to effects that cannot be reasonably mitigated. *Significant* in this section in most cases refers to effects classified as major. *Adverse* in this section is from the perspective of the majority, e.g., exposing rock layers in the walls of an open pit would be beneficial to a geologist, but most people would consider such as adverse to visual resources. This section is applicable to only action alternatives.

Soil profiles/textures would be damaged (compacted) or destroyed (removed) on large areas (100s acres) of the mine, with a decrease in soil nutrients, organic matter, and microbial communities. The salvage, storage, and replacement of soil would result in a soil loss of approximately 30 percent, and many of the reclaimed areas would have less soil than the pre-mine condition, e.g., 1 foot or less depth on the reclaimed WRSFs. Large areas of vegetation would be removed at the mine, and re-established during reclamation. However, the re-established vegetation would have relatively low productivity for decades, particularly since vegetation growth is relatively slow at high elevations. Large areas of conifer forest, including scattered, large-diameter trees (but not old growth), would be removed by the mine operations. These trees would be a source of seed cones that may produce trees that are particularly resistant to drought and disease. Even with tree seedlings planted as part of reclamation, conifer forests would not develop to their current stature and diversity for at least 150 to 200 years.

The flow of groundwater near the open pit would be into the pit until the pit begins to fill, and the developing pit lake would not function ecologically as a natural lake. In addition, as the pit fills, the flow of groundwater near the pit would gradually reverse causing the pit lake to affect the quality of groundwater near the pit. Development of the No Name WRSF (Alternative M3) would probably affect groundwater in a new drainage. The mine would fill a variety of WUS. The Pat Hughes WRSF (Alternative M2 and Alternative M3) and the No Name WRSF (Alternative M3) would not meet the VRM Class II designation from KOP 6 in the short term. The No Name WRSF (Alternative M3) would not meet the VRM Class II designation from KOP 2 in the short term. The mine development would be a distinct change in land use (timberland to molybdenum mining) in the short term.

Under Alternative L2, Alternative L4, and Alternative L5 the area suitable for grazing in the Thompson Creek Allotment Lower pasture and Unit 2 pasture would be reduced by 69 to 80 percent (71 to 80 % of the AUMs). Under Alternative L2-B there would be a distinct change in land use (farm/ranch to native vegetation/no grazing) and substantial costs to the BLM Challis Field Office annual budget and the operator of the Broken Wing Ranch.

4.19. Short-term Uses Versus Long-term Productivity

The goal of this section is to evaluate the extent to which, if at all, the alternatives would balance short-term uses of (or effects to) a resource with long-term productivity of (or effects to) the resource, i.e., provide a sense of the resilience (or sustainability) of a resource to short-term perturbations associated with an alternative. For example, a short-term construction detour in a business district could cause the district to collapse, affecting long-term economic productivity; or a short-term removal of soil from a large area could result in that area having a long-term decrease in agricultural or timber productivity. The relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity is applicable to only action alternatives. Short-term in this section refers to uses with a duration of a few years or less.

Most effects of the MMPO action alternatives would be long-term, e.g., soil compacted and/or removed from the WRSFs. However, soil would be compacted and/or removed in small areas (e.g., few acres) at the mine that would be reclaimed in the short term, e.g., maintenance work in utility corridors. Such short-term effects to soil would cause a minor effect to long-term soil productivity, particularly on steeper slopes or areas of relatively erodible soil. For example, it would take decades to re-establish any biological crusts. It would also take several thousand years to regenerate the original soil profile and texture at a typical soil production rate of 1 inch per 1,000 years, a typical soil loss of 30 percent for salvaged soil, and a salvaged soil layer approximately 1 foot thick. Similarly, small areas of sagebrush, grassland, and conifer forest would be removed in the short term at the mine, but despite immediate reclamation there would probably be minor effects to the long-term productivity of such plants and trees. In the case of Alternative L2-B, the short-term conversion of approximately half the ranch to native vegetation would result in long-term increases in native vegetation and forage for wildlife.

The effects of the land disposal alternatives would also be long-term. There would not be any short-term uses that would affect the long-term productivity of a resource.

4.20. Irreversible and Irretrievable Commitments of Public Resources

Irreversible commitments occur when a resource is permanently affected, consumed, or renewable only over long time spans, e.g., natural soil development of approximately 1 inch per 1,000 years. Irretrievable commitments occur when a resource is not consumed or destroyed but rather becomes unavailable for use for the foreseeable future, e.g., a decrease in public recreation opportunities due to a sale of Federal lands. This section is applicable to only action alternatives.

The mine would cause the permanent removal of a substantial amount of molybdenum. If the removal of molybdenum from private property were considered a "public" resource, then such removal would result in an irreversible commitment of public resources. The transfer of the selected land from Federal to private ownership would be an irretrievable effect on public availability of the mineral resources on the property. However, the known mineral resources would be extracted for the benefit of the public, the land would be managed by TCMC primarily for mineral development, and the probability of discovering additional valuable mineral deposits on the land would be remote.

Thompson Creek Mine FEIS
Errata

The following errata apply to the text of the FEIS as published:

FEIS Section	FEIS Page	Add or Change
1.9	1-22	Add: 1.9.24 Idaho Roadless Rule
1.9.24	1-22	Add: Idaho Roadless Rule - The USDA Forest Service adopted a roadless area conservation rule for National Forests (36 CFR Part 294) in Idaho in 2008. The rule established 250 Idaho Roadless Areas, assigned one of five established management themes to each area and provided prohibition with exceptions or conditioned permissions governing road construction, timber cutting, and discretionary mineral development.
3.12.1.1	3-205	Change: The S. Creek IRA (06-005; 99,620 acres) is on NFS land generally north, west and south of the analysis area. North of the analysis area, the perimeter of the IRA is along the top of the Buckskin-Basin Creek ridgeline, as close as 200 feet to the MMPO area (Alternative M2). The northernmost existing and planned extent of the TSF and its support facilities would include approximately ~~northernmost support facilities for the TSF extend 750 feet~~ one acre of the IRA, which in this area also contains a network of historic mining roads (some of which are used to access the Cinnabar mining claims north of the TSF).
4.12.1.1	4-146 4-147	Change: There would ~~not be any~~ be less than one acre of development or encroachment into the S. Creek IRA. Users of this IRA would not experience any different conditions from those currently experienced due to the mine. Changes to roadless character and wilderness attributes of the S. Creek IRA would be negligible. There would not be any other effects to SMAs.
6.2	6-4	Add: The Idaho Roadless Commission was briefed on the project.

Soil that would be distinctly compacted or salvaged at the mine would be an irreversible commitment because of the slow rates of natural soil regeneration. Similarly, the removal of conifer forest would be an irreversible commitment because of the slow rates of tree regeneration. Removal of shrubland and grassland (and 2 or 3 AUMs in the Thompson Creek Allotment) might be an irreversible commitment depending on how long it would take to re-establish the vegetation. Wildlife would be displaced from the mine site. The water used to fill the pit would be an irretrievable commitment of water resources affecting the hydrologic balance of the locality. The effects to the quality of surface water, groundwater, and fish habitat would be irreversible commitments, as well as the fill of the WUS (which would be greater under Alternative M3 than Alternative M2). However, the fill of WUS is fully mitigated (Appendix B). The open pit, WRSFs, and TSF would be irreversible effects to topography and visual resources, although reclamation would minimize the effects of the WRSFs and the TSFs to visual resources.

There would be an irretrievable commitment at the mine related to land use (conversion of timberland to molybdenum mining), and in some areas of the selected land there would be an irretrievable commitment of recreation resources (small areas that would not be available for public access). The mine would also require irreversible commitment of labor and fiscal resources, some of which might be considered public resources. There would be an irreversible commitment of one cultural site (not eligible for NRHP listing), and the potentially undiscovered cultural and paleontological resources in the areas in which the surface would be disturbed by mining. There would also be an irreversible commitment of unoccupied Federal land under the MMPO alternatives, and also (net decrease in Federal ownership of up to approximately 5,100 acres) under the land disposal alternatives. Under Alternative L2-B there would be an irretrievable commitment related to land use (conversion of a farm/ranch to native vegetation and eliminating grazing from a portion of the farm/ranch).

4.21. Mitigation and Monitoring

In addition to the mitigation and monitoring described below, adaptive management (Table 2.1-2) would be utilized in conjunction with monitoring (Table 2.1-4. and Table 2.1-7.) to ensure reclamation goals are met.

4.21.1. Geologic Resources and Geotechnical Issues

The following measures would be implemented under all MMPO alternatives. If unanticipated paleontological resources were encountered during mining, TCMC would immediately notify the Forest Service or the BLM authorized officer, and operations would be halted in the vicinity of the discovery until inspected by the Forest Service, the BLM, or an agency-approved paleontologist, and a mitigation plan developed, if necessary. Paleontological resources would be avoided until the Forest Service, the BLM, or an agency-approved paleontologist conducts investigations as needed to determine the significance of the fossils. At the discretion of the Forest Service or the BLM, these fossils would be avoided for a length of time that is reasonable (i.e., at least 10 days after notification to the authorized officer of such discovery) to allow agency personnel to conduct the investigations. TCMC would be responsible for the cost of these investigations, evaluations, and mitigations.

4.21.2. Vegetation, Forest Resources, and Invasive and Non-native Plants

The trees planted for reclamation could include whitebark pine seedlings in all disturbed areas within 100 vertical feet of ridgetops with an elevation of 7,300 feet or more, e.g., the head of the Buckskin Creek drainage. Such would result in stands of whitebark pine trees (long-term, moderate effect).

4.21.3. Water Resources

The Consolidated Environmental Monitoring Program 2007 to 2012 for the mine contains a Water Quality Monitoring Plan and Adaptive Management Plan (TCMC 2008a, Section 2.1.1.7). The program would be modified according to Lorax (2012b) to better identify potential water quality problems due to either inaccurate predictions or to operations (e.g., cutoff walls) not performing as intended. For example, the adaptive groundwater management Plan (Lorax 2012b) notes that additional groundwater monitoring in the colluvium and metasedimentary bedrock just downgradient (within 30 feet) of the cutoff wall should provide a better evaluation of the cutoff wall performance and hydraulic gradients between the cutoff wall and the drainage outlet. In addition, water level monitoring just upgradient of the cutoff walls using automated piezometers (for safety purposes at the toes of the WRSFs) would allow the determination of the hydraulic gradient across the cutoff wells, which would also provide a better evaluation of the cutoff wall performance. Furthermore, the Phase 8 pit wall could be mapped for major faults/fractures that could convey pit lake water to the groundwater near the pit. Such data could be integrated into a subsequent groundwater monitoring system to evaluate the potential effects of the pit lake on groundwater. The Lyon Creek ford at the Broken Wing Ranch could be armored to reduce downstream turbidity and sediment deposition.

4.21.4. Wetlands, Floodplains, and Riparian Areas

The wetland and stream mitigation plan (HDR 2014b) would mitigate the effects of the MMPO alternatives on WUS (Appendix B). The objective of the proposed wetland and stream mitigation is to protect streambanks along S. Creek from damage caused by livestock and to reestablish a 5.64-acre wetland along S. Creek. Protecting the streambanks would be accomplished by fencing out livestock and the repair or restoration of 100 feet of bank using bio-engineering as described in the wetland and stream mitigation plan (Appendix B). Reestablishing the wetland would involve earthwork and plantings. Contractors would be required to implement a SWPPP during the construction and vegetation establishment phase of the wetland and stream channel rehabilitation work.

Over time it is expected that fencing S. Creek to exclude livestock would naturally allow rehabilitation of the streambanks along S. Creek. The natural processes would include reestablishment of the riparian vegetation and a reduction in erosion along the streambanks. The reestablishment of vegetation would reduce sediment load and benefit water quality. Additional vegetation along the S. Creek streambanks would create more shade, which could have minor benefits on the water temperature and would create additional habitat and cover for wildlife. Fish and aquatic resources would benefit from the reduction in turbidity and water temperature and would have higher-quality streambank habitat. The fencing would not interfere with wildlife access to S. Creek.

The proposed new wetland that would be developed as part of the mitigation would be located between the gravel access road and S. Creek. Based on observations in the field, it is likely that this area was a wetland that was drained and filled in the past. Once completed, following the vegetation establishment phase (1-3 years), the wetland would provide habitat for breeding, foraging, and cover for birds, water fowl, mammals, reptiles, and amphibians. The restored wetland would be fenced to control access, and manage potential grazing rotations. The proposed stream and wetland mitigation would have negligible effects on the overall ecosystem of the S. Creek drainage.

4.21.5. Visual (Aesthetic Resources)

The effect of the No Name WRSF on visual resources could be reduced in the long term by planting trees to partially block the view of the facility from KOP 2 and other areas along Thompson Creek Road. If trees were planted at or before the initial development of the facility, the trees would reach a size to break up or block views by the time the facility would be visible from the KOP. Reclamation could also include measures to reduce effects of the WRSFs and the TSF such as regrading the margins of the facilities in a "feathering" pattern to better blend with the surrounding topography. The rock features most visible due to color contrast could also be stained (oxidized) to reduce the contrast.

4.21.6. Cultural Resources

The adverse effect related to the Cinnabar/Bruno Creek Mine/ lithic scatter (10CR758) would require the development and approval of a cultural resource mitigation plan and further consultation with the SHPO, National Advisory Council, and the Tribes. Completion of the NHPA Section 106 consultation process would require a ground survey of the site to determine which, if any, significant site components would be affected by the MMPO. If any site components that would contribute to the significance of the site would be adversely affected by the MMPO, then a mitigation plan would be developed, agreed upon, and implemented before any ground-disturbing operations could occur.

The measures described for the unanticipated discovery of paleontological resources (Section 4.21.1.) would be implemented under all MMPO alternatives for the unanticipated discovery of cultural resources.

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